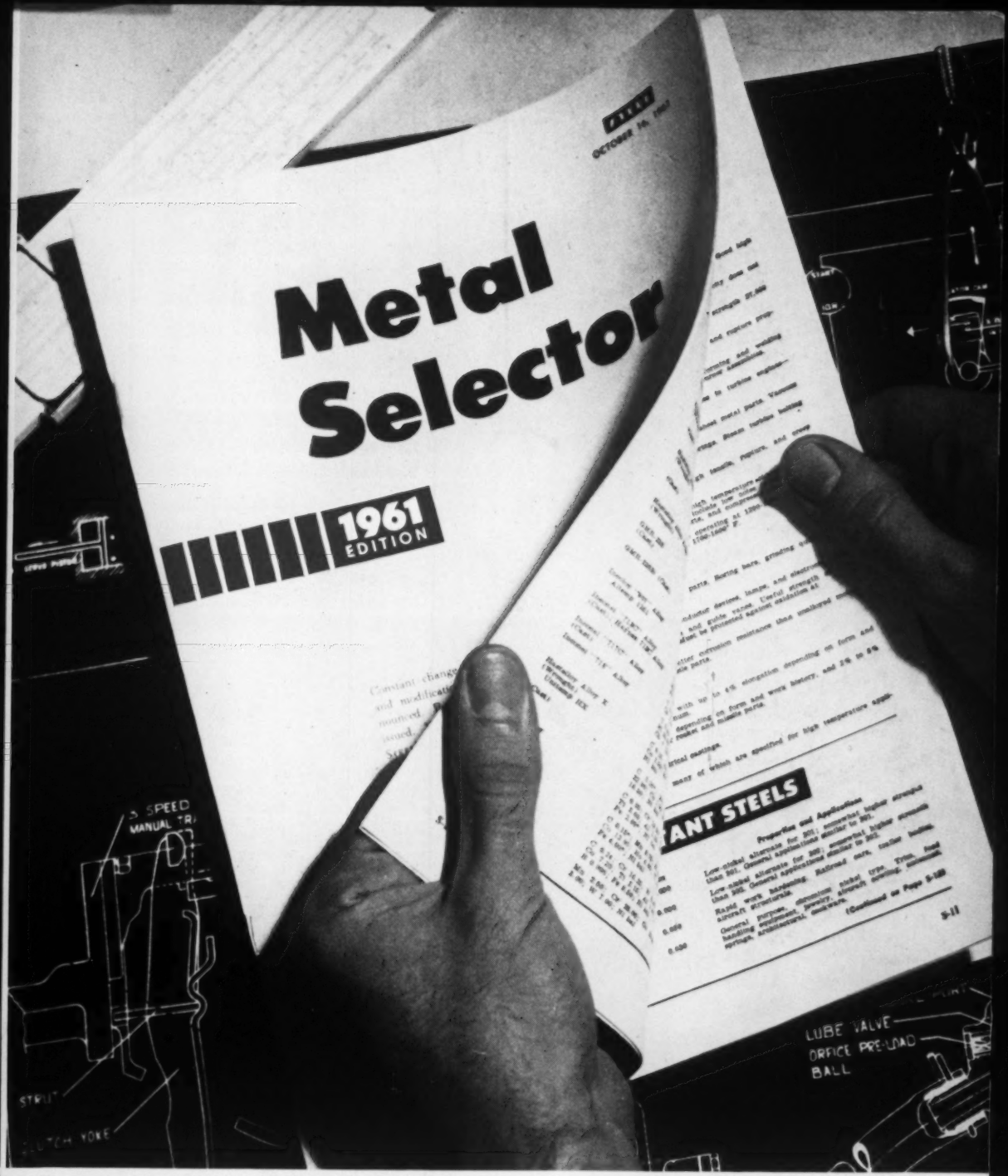
STEEL
The Metalworking Weekly
A PENTON PUBLICATION
OCTOBER 16, 1961



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COMPLETE CONTENTS—PAGE 19

A NEW TOOL-SETTING METHOD

Tool-Tronic Gage locates tool tip within .000025 by fast, simple electronic-optical method

by Alden H. Jacobson, Chief Engineer
Bore-Matic Division
The Heald Machine Company

With today's trend to greater accuracy and precision in single-point Borizing, the problem of precise tool-tip location becomes increasingly important.

Previous methods, while of high accuracy, are relatively slow and require considerable skill on the part of the operator. The optical method, using a precision-calibrated microscope, is dependent on the relative degree of operator eye fatigue. If eyestrain is a result, such an undesirable condition is known as "eyeballing." And the touch method, using dial indicators, often causes microscopic damage to the cutting edge with resulting impairment of the finished surface.

Here at Heald we have devoted a great deal of research to devise a method of tool-setting which would maintain the highest accuracy, prevent tool tip damage, and require no special operator skill.

The result is the new Tool-Tronic Gage illustrated here. Tool tip location is precisely determined by optical means, with electronic amplification giving highly accurate readings on two large meter scales.

The unit consists essentially of a sensing head which contains the light source, optics and photo cells, and a separately mounted amplifier and meter case. The sensing head is mounted vertically on the machine near the workhead, where the tool can be positioned into gage opening. As the tool is moved into place by operation of the table and cross slide, it interrupts the light rays and the amount of light passing on each side of the tool is compared to reference photocells and read out on two large horizontal-scale meters. To locate the tool with an accuracy of 25 millionths, it is only necessary to move tool in X and Y directions until the pointers on both meters are centered on the "zero" mark. For the operator to determine this precise position and return to it whenever desired requires no more skill or experience than that needed to operate the machine.

The Tool-Tronic Gage can be used with most types of single-point boring and turning machines. It should prove especially valuable on numerically-controlled contour Borizing equipment where extreme precision is required.

Tool-Tronic Gage, showing meter case, sensing head and cable.

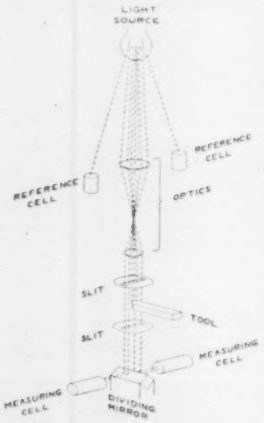
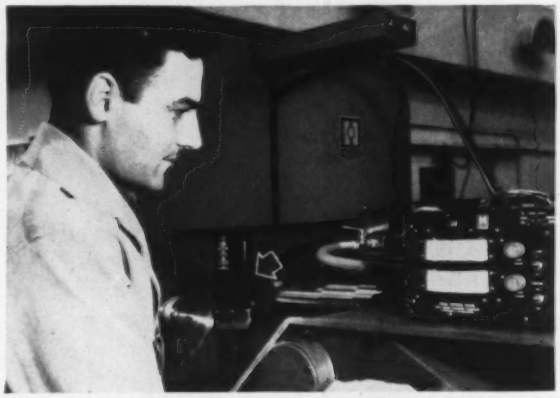


Diagram showing principle of operation of Tool-Tronic sensing head.



Tool-Tronic gage in use on a numerically-controlled Heald Model "S" Bore-Matic. Sensing head (arrow) receives tool and centering indication is read on meters at right.

Your Heald engineer will be glad to arrange a demonstration of this new tool setting gage for you, in your plant or ours.

It Pays to come to Heald

THE HEALD MACHINE COMPANY

Subsidiary of The Cincinnati Milling Machine Co.
Worcester 6, Massachusetts

KNOW YOUR ALLOY STEELS . . .

This is one of a series of advertisements dealing with basic facts about alloy steels. Though much of the information is elementary, we believe it will be of interest to many in this field, including men of broad experience who may find it useful to review fundamentals from time to time.

How Alloy Steels Respond to Induction Hardening

In the induction-hardening process, steel is first heated above the transformation range by means of electrical induction, then quenched as required. Special equipment is needed, and heat is developed as follows:

High-frequency alternating current passes through a coil or inductor, with the result that a magnetic field is created in the coil. When the piece to be treated is placed in this field, it is heated rapidly by induced energy. With the various types of induction-heating equipment, the process is capable of surface- or case-hardening to various controlled depths; however, through-hardening can be obtained with certain alloy steels. Ferrous metals that respond well to induction hardening include numerous grades of both alloy and carbon steels, as well as hardenable stainless steel and plain or alloyed cast iron.

As a rule, when alloy steels which contain non-carbide-forming elements, such as nickel, are heated by induction, the usual hardening temperatures can be used. But with alloy steels that do contain carbide-forming elements such as chromium, molybdenum, and vanadium, the hardening temperature must be increased if the normal effect of the alloying elements is desired.

Hardness obtained by the induction process is a function of the carbon content and prior structure, just as it is when conventional heating methods are used. Nevertheless, higher surface-hardness values for a given carbon content have often been noted in parts subjected to surface induction-hardening. The extra hardness may be as much as five Rockwell C points for steels of 0.30 pct carbon.

As pointed out previously, the induction method requires special equipment. However, it possesses several marked advantages, including speed of heating and cleanliness of operation. Pieces heated by induction are usually subject to a minimum of scaling and distortion. Moreover, induction-hardening equipment is very compact and therefore conserves floor space.

If you would care to know more about the induction hardening of alloy steels, please communicate with our technical staff. Bethlehem metallurgists have made a thorough study of the subject, including the many details of quenching and tempering. Call them if they can help you in any way. And remember, too, that Bethlehem makes the full range of AISI standard grades, as well as special-analysis steels and all carbon grades.

This series of alloy steel advertisements is now available as a compact booklet, "Quick Facts about Alloy Steels." If you would like a free copy, please address your request to Publications Department, Bethlehem Steel Company, Bethlehem, Pa.

Steel

for Strength . . . Economy . . . Versatility

BETHLEHEM STEEL COMPANY, BETHLEHEM, PA. *Export Sales:* Bethlehem Steel Export Corporation

BETHLEHEM STEEL

BETHLEHEM STEEL

precise tubular products

In a wide variety of forms and shapes of stainless steel, nickel, nickel alloys, super and "exotic" alloys—also in precious metals and alloys:

- Capillary and Hypodermic Tubing
- Glass-to-Metal Sealing Alloys
- Clad Metals and Composite Wires
- Fabricated Specialties

And a complete line of seamless, welded, and drawn tubing up to 1" O.D.

Write for Bulletin No. 12

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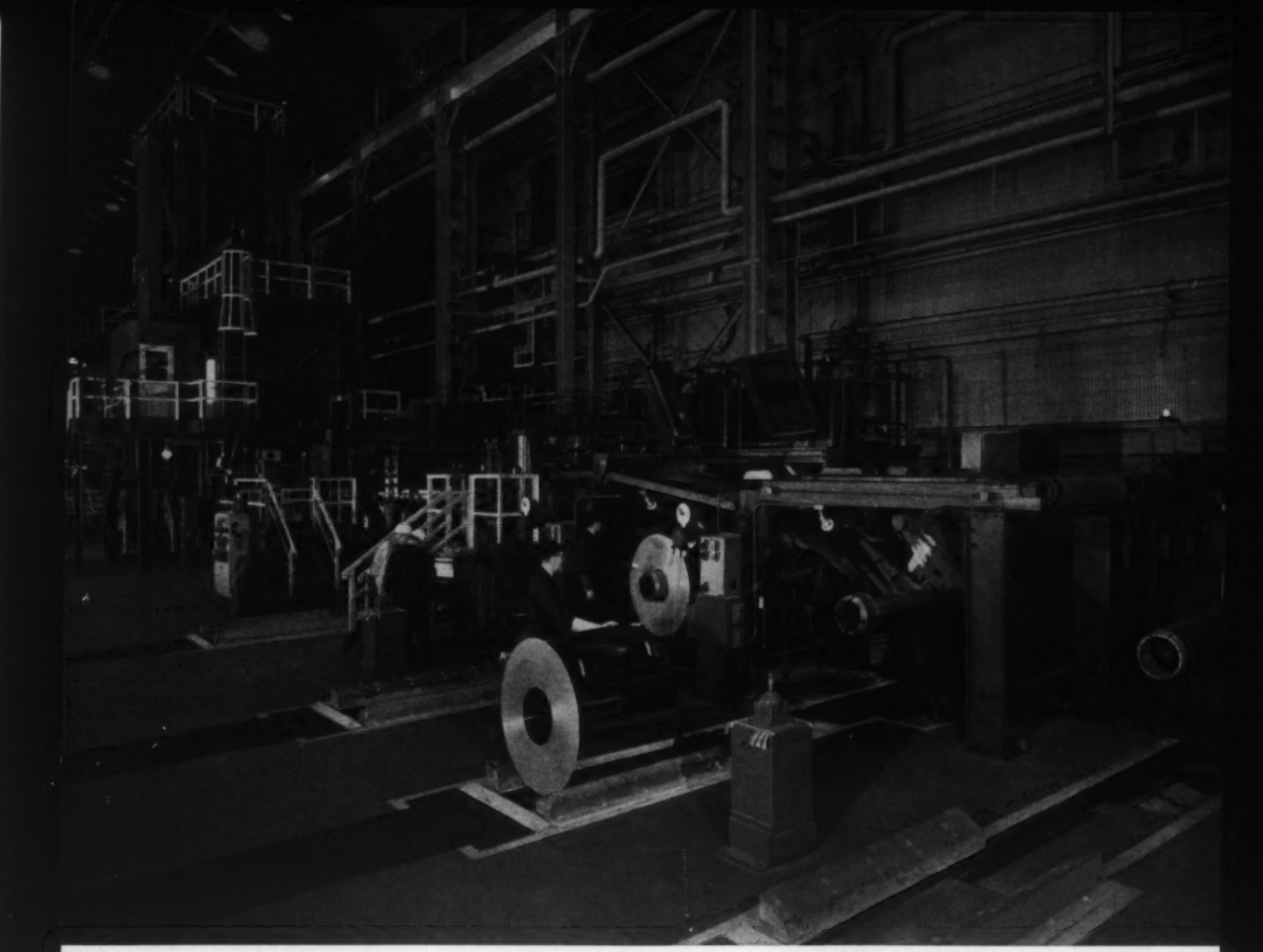


Inland Steel boosts tin plate production with modern, Wean Electrolytic Tinning Line

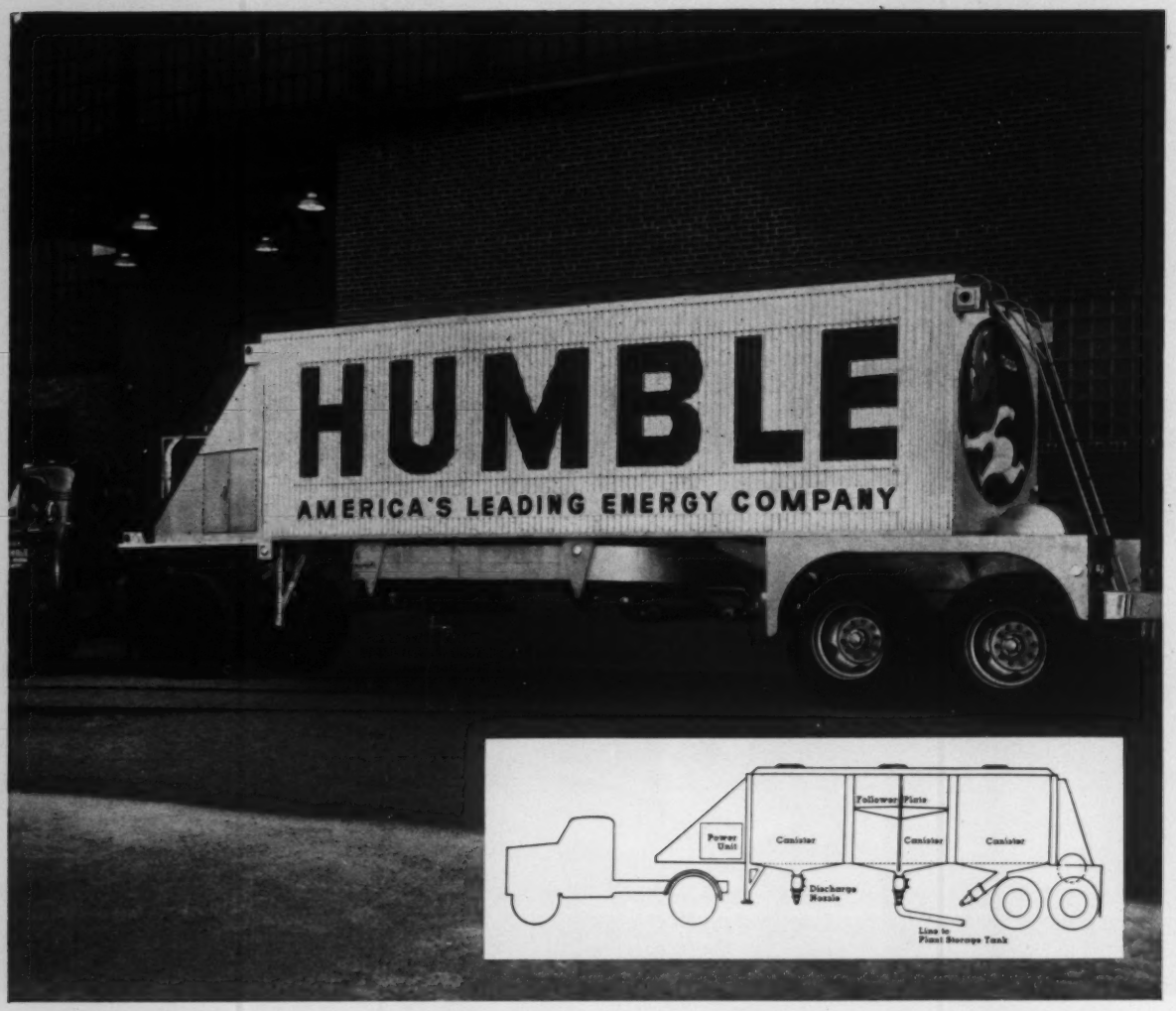
In an expansion of its tin plate production to serve the can manufacturing market, Inland Steel Company recently installed this high speed Wean electrolytic tinning line. The third Wean tinning line in operation at Inland, this line is also the widest Ferrostan line built to date, incorporating the most modern design features in electrolytic tinning.

Operating at speeds up to 1250 fpm, the No. 3 Wean line is capable of handling 48,000 lb. coils up to 73″ O. D., with a maximum strip width of 43″ at the entry end. A reject reel at the entry end collects off-gage material. Line arrangement at the exit end permits continuous recoiling of tinned strip at the same time finished coils are being sheared. Other equipment includes a side trimmer for trimming in the line. A single sheet classifier speeds and simplifies handling of finished materials.

Fifty-three Wean electrolytic tinning lines now produce over 80% of the world's tin plate supply. In a 32-year partnership with the steel industry, Wean has pioneered many of the technological advances in today's continuous processing systems. When your planning involves electrolytic tinning, galvanizing, cleaning, pickling or shearing equipment, Wean's "Creative Engineering" can build the facilities to meet your needs.

WEAN

THE WEAN ENGINEERING COMPANY, INC. • WARREN, OHIO



NEW DELIVERY SYSTEM CUTS GREASE-HANDLING COSTS

The new Humble grease truck shown above increases the speed and efficiency of bulk grease delivery, and makes possible added savings in storage and handling of lubricants within your plant. The possibility of in-plant grease contamination is virtually eliminated. It's another example of our constant efforts to bring you better products and service—whether you use a can or a carload.

As the diagram indicates, the specially designed insulated trailer body carries three cylindrical canisters, each holding about 10,500 pounds of grease. These compartments are separately filled and emptied—so that up to three different types of grease can be handled without intermixing.

Your Humble Representative, backed by our conveniently located Sales Service Laboratories, can help you improve your lubrication practices. Contact him, or write us at 15 W. 51st St., N.Y. 19, N.Y.

HUMBLE OIL & REFINING COMPANY ESSO

New Man

Charlie Goerth is a new assistant editor. He'll be doing general news assignments. After being graduated in 1954 from the University of Cincinnati, he went into the Air Force and is now a captain in the reserves.

When he returned to civilian life, he joined KYW radio and television in Cleveland as assistant public relations director. He and his wife, Jean, have two children, Lise, 2½, and Gretchen, almost 1.

Charlie translates from German as a hobby—his translation of a German work on mob psychology is being considered by a New York publisher. He's now translating a German manuscript written by one of Fidel Castro's ex-lieutenants.

Growing

The addition of Charlie Goerth to the staff brings the number of editors to 33. That compares with 26 as recently as ten years ago.

Art Corner

The work of Stanley Kaplan, a former Levittown, N. Y., art teacher who turned professional muralist, will be on display at the National Retail Lumber Dealers Association's exposition in Chicago, Nov. 4-7.

Mr. Kaplan's technique combines woodcut-making, conventional oil painting, and carpentry. Also involved is an element of stevedoring because the murals are made of heavy planks.

The scene of the exhibition will be the booth of the International Concatenated Order of Hoo-Hoo, the lumberman's fraternity.

Communications Improved

Here's a bit of spoof we picked up from Jim Larkins, editor of *Cleveland Engineering*, magazine of the Cleveland Engineering Society:

The technology of graphic communications took a giant leap forward today as J. S. Larkins Corp. finalized the pilot models of an instrument for transmitting human thought.

Called the "Pentzil," the concept promises to outperform—and perhaps eventually replace—the hammer-and-chisel facilities now commonplace in upper income caves.

Observers at the initial tests, conducted Oct. 1, 3010, in the manufacturer's Advanced Testing Laboratories in Cleveland were impressed with the speeds achieved even by unskilled laymen as they wielded pilot models. The instrument is based on the friction, or flint-spark principle. The unit seems to be constructed of wood, metal, rubber, and graphite. Graphite, a rare compound, is composed chiefly of kharbon, an element which was prevalent in the terratial subsurface prior to Atomic War II, which destroyed all the combustible artifacts of latterday Terration Culture.

New Arrival

Up on the ninth floor we kept hearing the editors referring to the Case baby. We thought that Metallurgical Editor Ed Case had become a father for the fourth time. We learned that is not the case. The reference is to the Metal Selector which Ed did father. The cribroom is to the east of here on Page 117. Visiting hours are anytime you care to choose. The baby is a beauty.

Incidental Intelligence

Item: Happy Breath is an oral hygiene product intended for 40 per cent of the nation's 22 million dogs that have halitosis.

Item: A great lover of the future may pause as he is about to kiss the girl and ask: "Have you any cavities?" Research suggests that tooth decay can be transmitted.

Item: A self-service gasoline vending pump capable of accepting coin or credit card insertions is among the 173 new products and processes listed in the Small Business Administration's September Products List Circular.

Item: Thor Power Tool Co., Aurora, Ill., will offer $100 for information leading to the location of the oldest Thor power screw driver (air or electric) still in service.

Item: The world's first commercial airline was established between Tampa and St. Petersburg, Fla., in 1914.

Puzzle Corner

How many pieces of type does a printer need to set up page numbers for a 288 page book if he doesn't use any piece twice?

STEEL, the metalworking weekly, is selectively distributed without charge to qualified management personnel with administrative, production, engineering, or purchasing functions in U. S. metalworking plants employing 20 or more. Those unable to qualify, or those wishing home delivered copies, may purchase copies at these rates: U. S. and possessions and Canada, $10 a year; all other countries, $30 a year; single copies, 50 cents. Metalworking Yearbook issue, $2. Published every Monday by The Penton Publishing Co., Penton Bldg., Cleveland 13, Ohio. Accepted as controlled circulation publication at Cleveland, Ohio.

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Fluid Power News

OILGEAR 1921 1961 40 Years of Fluid Power

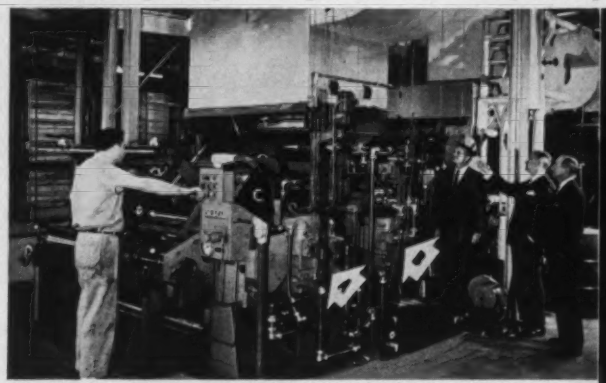
Report No. 11,806 From Oilgear *Application-Engineering* Files

HOW OILGEAR HEAVY-DUTY *Any-Speed HYTAC** DRIVE SYSTEMS ON *Anaconda's* NEW FOIL LAMINATING AND COATING MACHINES HELP SPEED PRODUCTION — CUT COSTS

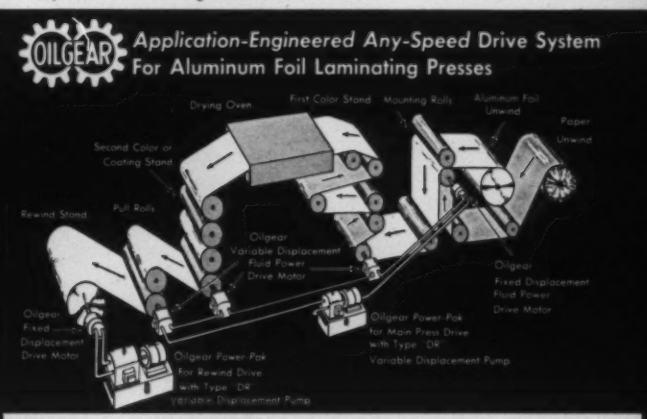
USER: *The Anaconda Aluminum Company, Louisville, Kentucky, Fair Lawn, New Jersey, Terre Haute, Indiana*
(Machine Builder — New Era Manufacturing Company, Hawthorne, New Jersey — successor to Meisel Press Manufacturing Company, Boston, Mass.)

PROBLEM: Main and Rewind Drive Systems for two, new, high-speed laminators to bond aluminum foil as thin as 0.0002" to paper stock ranging from 15-lb tissue to 0.020" carton and food board. In addition to laminating, these "presses" must simultaneously coat and/or color the foil.

REQUIREMENTS: 1. Accurate, wide range, dependable tension control to accommodate *Anaconda's* complete range of laminating foils and paper stock. 2. Infinitely variable, stepless speed range from 0 to 1000 fpm—capable of an optimum, continuous 850 fpm running speed. 3. Maintain tension accurately in "stall" condition indefinitely without overheating—and then pick up speed smoothly and quickly without snapping the sometimes fragile web. 4. Reduce costs through reduction of scrap, repair parts inventories, and machine downtime . . . operate at nearly three times former production speeds. 5. Must be: compact, to conserve valuable floor space; economical on electric power input; capable of continuous, three-shift operation.



ABOVE: One of Anaconda Aluminum's new, Oilgear-equipped, high-speed foil laminating and coating presses—rewind end—as installed at their Louisville, Kentucky, Laminating Plant. Roll cores—8¾" dia. . . . web width—from 23" to 52" . . . roll diameters—to 60" . . . roll weights—to 4500-lb. Tension range—from ½-lb/in. to 4-lb/in. depending on weight of lamination being processed. Arrows (A), (B)—Oilgear Variable Displacement Drive Pumps. Arrow (C)—one of two pushbutton control stations at opposite ends of the press—3 emergency "stop" buttons are located at other positions.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Application-Engineered Any-Speed Drive System
For Aluminum Foil Laminating Presses
Drying Oven
First Color Stand
Mounting Rolls
Aluminum Foil Unwind
Paper Unwind
Second Color or Coating Stand
Rewind Stand
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Oilgear Variable Displacement Fluid Power Drive Motor
Oilgear Fixed Displacement Fluid Power Drive Motor
Oilgear Fixed Displacement Drive Motor
Oilgear Power Pak for Rewind Drive with Type DR Variable Displacement Pump
Oilgear Power Pak for Main Press Drive with Type DR Variable Displacement Pump

Oilgear's patented *Any-Speed HYTAC** Drives (details not shown above) hold any preselected speed within ±0.1% under constant torque loads—within ±0.5% regardless of load, electric power variations, or temperature and viscosity changes . . . provide cushioned starting, remote jogging and threading . . . smooth, even let-off or build-up tensions . . . constant torque . . . adjustable tension . . . hydrodynamic braking. Applied to center shaft winders, *Any-Speed HYTAC** Drives automatically sense and compensate for changes in overall machine speed, and can automatically provide constant, adjustable, or tapering tension over a 20:1 winding range without dancer or follower rolls.

*HYTAC—A registered Oilgear Trademark

SOLUTION: Oilgear *Any-Speed HYTAC** Main and Rewind Drive and Tension Control Systems—as symbolized in the schematic sketch—above right. These compact, heavy-duty systems have successfully met or exceeded all originally specified requirements in continuous, three-shift, high-speed operation. Oilgear Drives were selected for these new machines because of: 1. The enviable record of maintenance-free long-life in several Anaconda Aluminum Plants. For example—six out of seven original, 300-fpm laminating presses at Louisville are Oilgear-equipped . . . two operating continuously since 1946. These 14-year-old drives—and two others—*have NEVER required maintenance other than oil changes and an occasional drive shaft seal.* The other two Oilgear Drives—installed in 1948—were disassembled three years ago merely for a preventive maintenance check—haven't been "touched" since. 2. Oilgear's accurate, dependable tension and speed control over a wide range—for smooth, precise, trouble-free operation on Anaconda's *entire range* of laminating stocks. 3. Space saving—Oilgear Drives occupy less floor space . . . do not require high-speed blowers for cooling—can hold stall-speed indefinitely without overheating. 4. Economy—in electrical power input, maintenance, virtually eliminate costly machine downtime and spare parts inventories . . . and in many cases—at lower installed cost.

Unbelievable? — Not to Oilgear Users! There are case histories upon case histories on file of machines equipped with *Application-Engineered Oilgear Drive Systems* that are rolling along—efficiently, quietly—with over 20 years of trouble- and maintenance-free service! Some additional *installation-proved* reasons . . . the greater accuracy, precision control of speeds, torques, tensions . . . new economies of operation, installation, and valuable floor space . . . are why more and more Oilgear users in the paper, printing and converting, food and beverage, marine, chemical, pharmaceutical, primary metals, metalworking, textile, rubber, military, and other industries all agree that . . .

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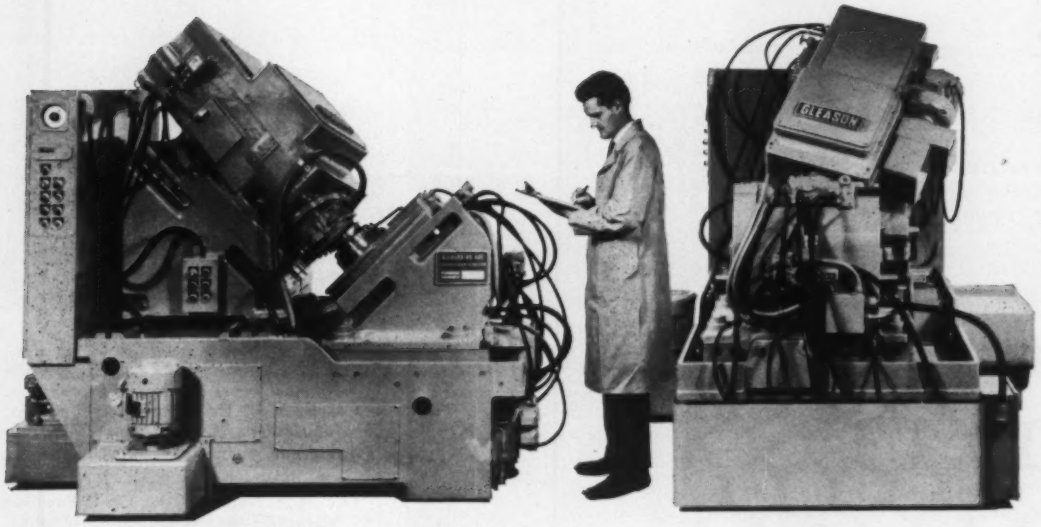
...PRODUCES QUIET, ACCURATE GEARS, UP TO 50% FASTER...AND SAVES FLOOR SPACE. These new Gleason "inclined-spindle" Hypoid Gear Cutting machines are primarily designed for faster, more accurate roughing and finishing of automotive main drive gears up to 10½" O.D. ■ Unique "inclined-spindle" design provides greater rigidity for precision cutting. ■ New type cutters, faster index and work clamp arrangements combine with automatic loaders to increase production up to 50%. ■ Yet, these new machines occupy 35% less floor space than previous machines. ■ Set-up and operation are simplified . . . only four summary settings with simple gage bars to relate work and cutter. Any number of machines can be set-up with the same gage bars to produce identical gears . . . no expensive set-up fixtures needed. ■ New magnetic chip removal and coolant systems assure constant forced flow of clean oil over the work . . . help prolong cutter life, eliminate periodic cleaning, and minimize coolant loss. ■ For information on these all-new machines write Gleason Works, 1000 University Avenue, Rochester 3, New York.

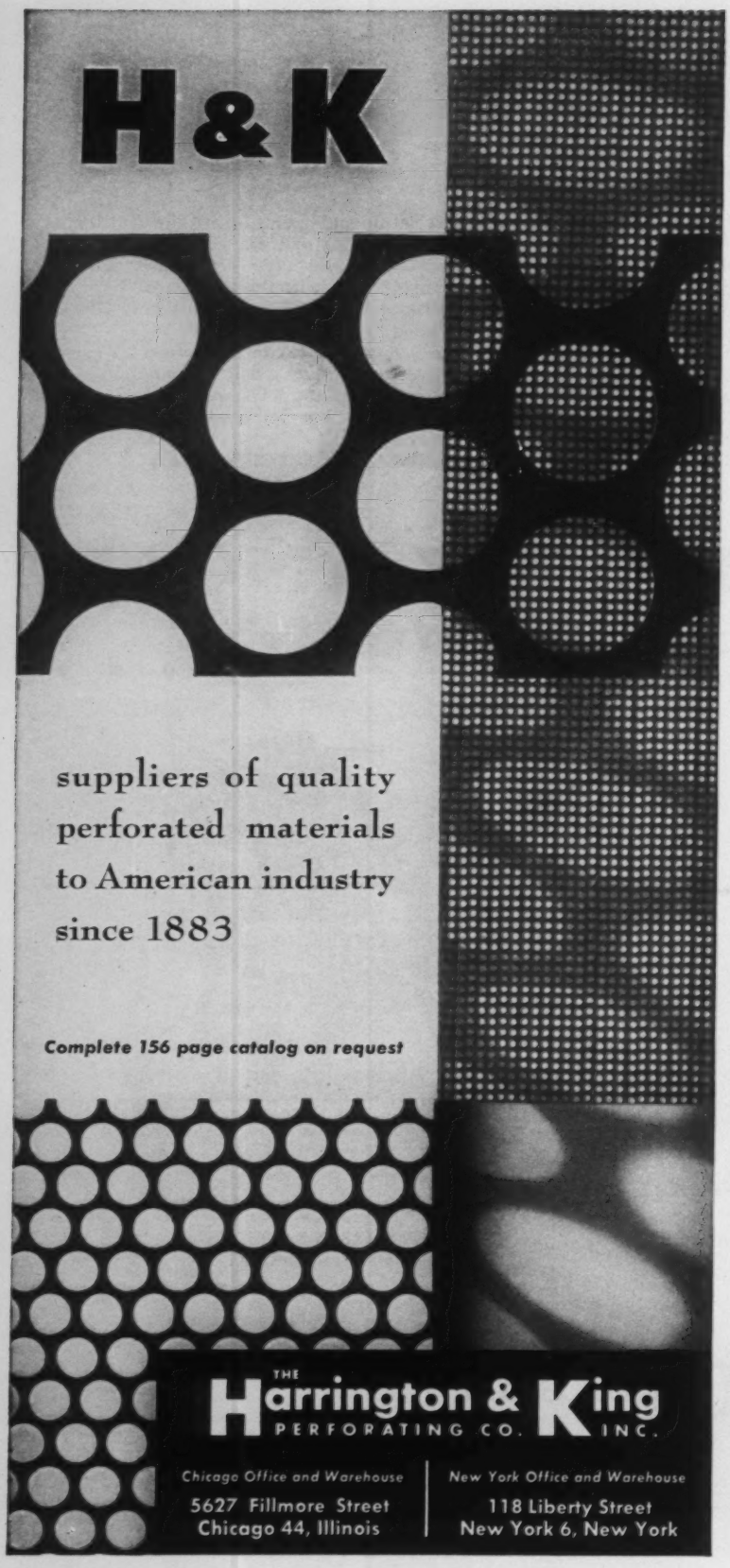
A BRAND NEW ANGLE IN GEAR CUTTING . . .



NEW GLEASON No. 606 Hypoid Gear Rougher

NEW GLEASON No. 607 Hypoid Helixform Gear Finisher

GLEASON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CALENDAR
OF MEETINGS

Oct. 18-20, Gray Iron Founders' Society Inc.: Annual meeting, Royal York Hotel, Toronto, Ont. Society's address: 930 National City-E. 6th Bldg., Cleveland 14, Ohio. Executive vice president: Donald H. Workman.

Oct. 18-20, Packaging Institute: Annual forum, Biltmore Hotel, New York. Institute's address: 342 Madison Ave., New York 17, N. Y. Executive director: Chas. A. Feld.

Oct. 19-21, Foundry Equipment Manufacturers Association Inc.: Annual meeting, Greenbrier Hotel, White Sulphur Springs, W. Va. Association's address: Suite 202, 1 Thomas Circle, Washington, D. C. Secretary: C. R. Heller.

Oct. 20-21, Rail Steel Bar Association: Annual meeting, Drake Hotel, Chicago. Association's address: 38 S. Dearborn St., Chicago 3, Ill. Secretary: W. H. Jacobs.

Oct. 23-25, National Fluid Power Association: Fall meeting, Sheraton Hotel, Philadelphia. Association's address: 5595 N. Hollywood Ave., Milwaukee 17, Wis. Executive vice president: Barrett Rogers.

Oct. 23-26, Metallurgical Society of AIME: Fall meeting, Pick-Fort Shelby Hotel, Detroit. Society's address: 29 W. 39th St., New York 18, N. Y. Secretary: R. W. Shearman.

Oct. 23-26, Wire Association: Annual meeting, French Lick-Sheraton Hotel, French Lick, Ind. Association's address: 453 Main St., Stamford, Conn. Executive secretary: Richard E. Brown.

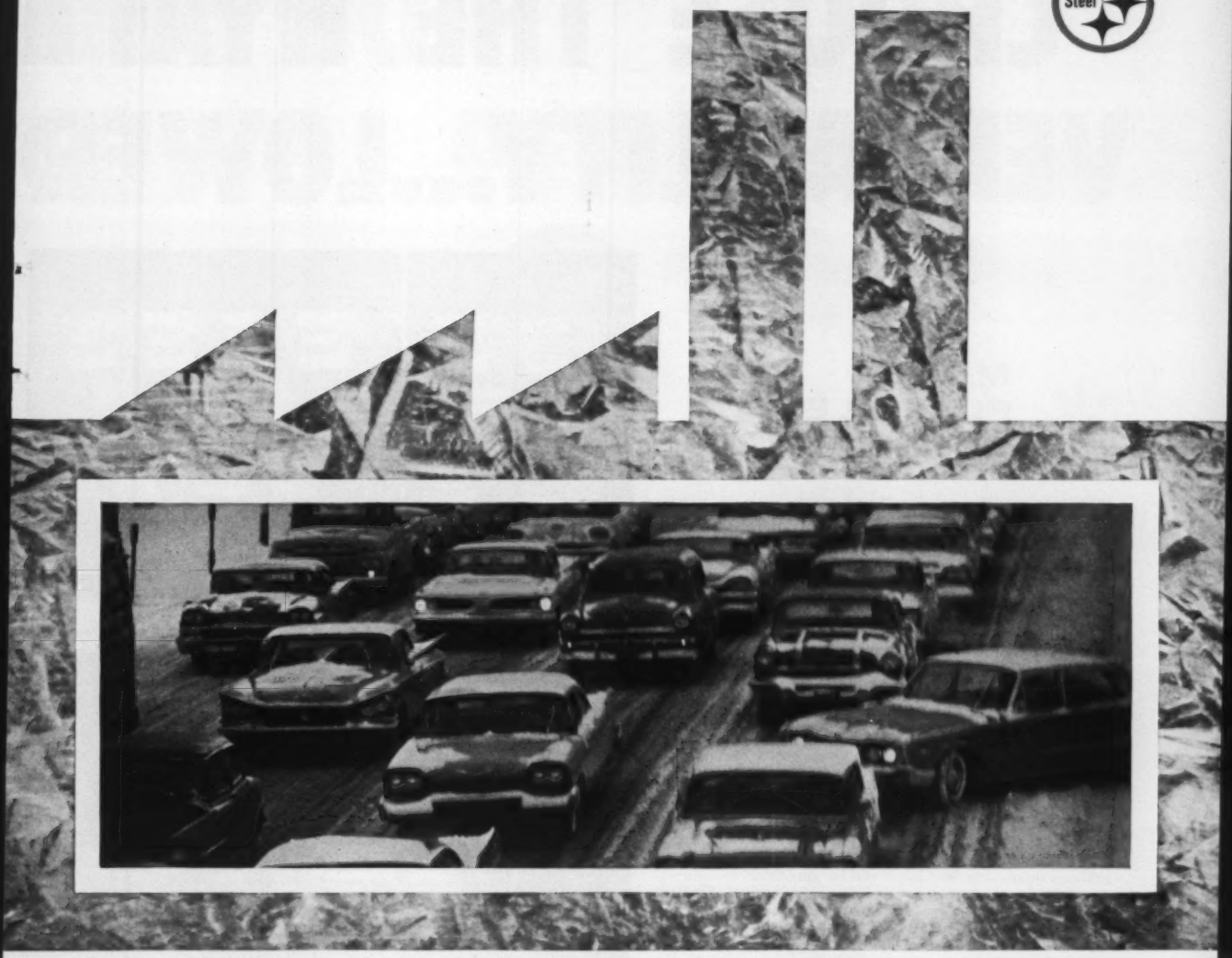
Oct. 23-27, American Society for Metals: National metal congress and exposition, Cobo Hall, Detroit. Society's address: Metals Park, Novelty, Ohio. Managing director: Allan Ray Putnam.

Oct. 24-28, National Tool, Die & Precision Machining Association: Annual meeting, Huntington-Sheraton Hotel, Pasadena, Calif. Association's address: 907 Public Square Bldg., Cleveland, Ohio. Executive secretary: Charles R. Bender.

Oct. 25-27, National Management Association: Annual convention, Sherman Hotel, Chicago. Association's address: 333 W. First St., Dayton 2, Ohio. Executive vice president: Marion Kershner.

Oct. 25-28, Metal Treating Institute: Annual fall meeting, Sheraton-Cadillac Hotel, Detroit. Institute's address: 271 North Ave., New Rochelle, N. Y. Executive secretary: C. E. Herington.

The new generation of U.S. autos fends off corrosion . . .



GUARDED BY GALVANIZED STEEL

Use of galvanized steel sheets in the automotive industry has increased by more than 700% since 1954—and more automotive applications are on the way.

As a result of this growing addition to Detroit's diet, both consumers and manufacturers are benefiting. To car owners, every pound of galvanized steel means more complete corrosion protection, added durability and savings in maintenance. To manufacturers, galvanized steel's simplified fabricating procedures bring reduced costs. Head and tail lamp housings, for instance, formerly required five or six steps when zinc plated or painted after stamping. Now they are moved direct from press to assembly line with their tight zinc coatings completely undamaged by fabrication. This also applies to side members, rocker panels, front and rear rails and cross members.

WEIRKOTE, IN PARTICULAR! One of the leading galvanized steels, Weirkote is widely used in the latest model automobiles. To the inherent strength, economy and versatility of steel, Weirkote adds enduring zinc protection via the modern continuous process. As a result, it can be worked to the very limits of the steel base without chipping or peeling. And it assures you long-lasting protection against corrosion. It is manufactured by two National Steel divisions, Weirton Steel Company and Midwest Steel Corporation. Write Weirton Steel Company, Weirton, West Virginia, for further Weirkote details.

MIDWEST STEEL
Portage, Indiana

WEIRTON STEEL
Weirton, West Virginia

divisions of
NATIONAL STEEL CORPORATION

CHOOSE THE HYATT VERSATILITY...LOWER

* MORE FLEXIBLE ASSEMBLY

Interchangeability of Hyatt separable bearing parts permits more flexible assembly. Any HYATT Metric Radial Series separable inner race, for a given piece number, can be assembled with any HYATT outer race and roller assembly of the same piece number.

Because of this interchangeability, it is practical to install separable HYATT inner races on shafts in one location, while the outer races and rollers are installed in housings at another location. When the sub-assemblies are brought together, the bearing parts will match perfectly. There is seldom need for selective assembly.

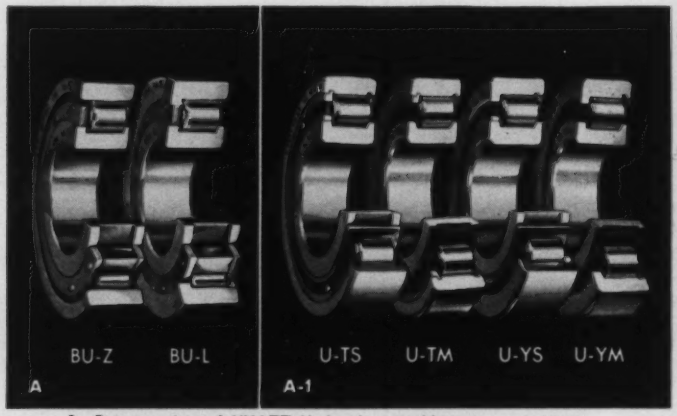
* INCREASED SHAFT DIAMETERS

When the designer wishes to use a larger, more rigid shaft, without increasing the size of the housing bore, he utilizes another advantage of HYATT separable bearings. He can eliminate the inner race of the separable inner race HYATT bearing types and operate the bearing rollers directly on the suitably hardened and ground shaft. Space usually occupied by the inner race is available for a larger shaft.

* REDUCED HOUSING BORE SIZES

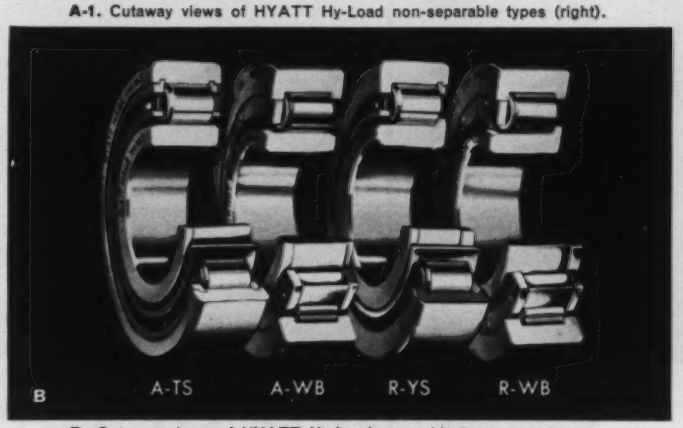
On the other hand, when space limitations force you to reduce the size of the housing bore without decreasing shaft diameter, versatile HYATT separable bearings are again the answer. This time you merely eliminate the outer race of one of the separable outer race HYATT bearing types—and operate the rollers directly on the suitably hardened and ground bore. You save the space normally occupied by the outer race.

And, of course, in applications where it is advisable to retain the complete bearing parts as a unit, HYATTS are available in non-separable assemblies.



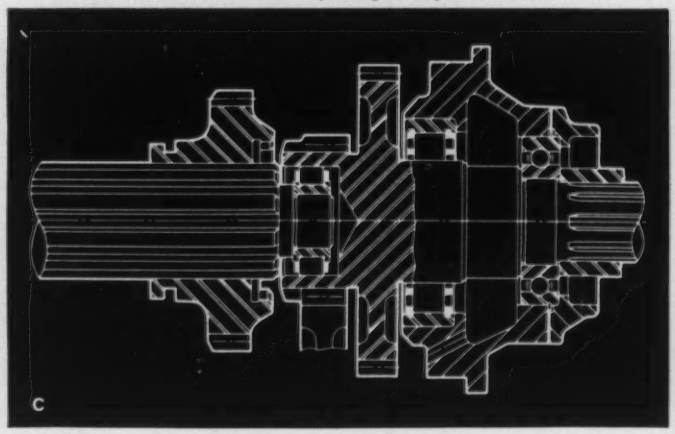
A. Cutaway view of HYATT Hy-Load separable outer race types.

A-1. Cutaway views of HYATT Hy-Load non-separable types (right).



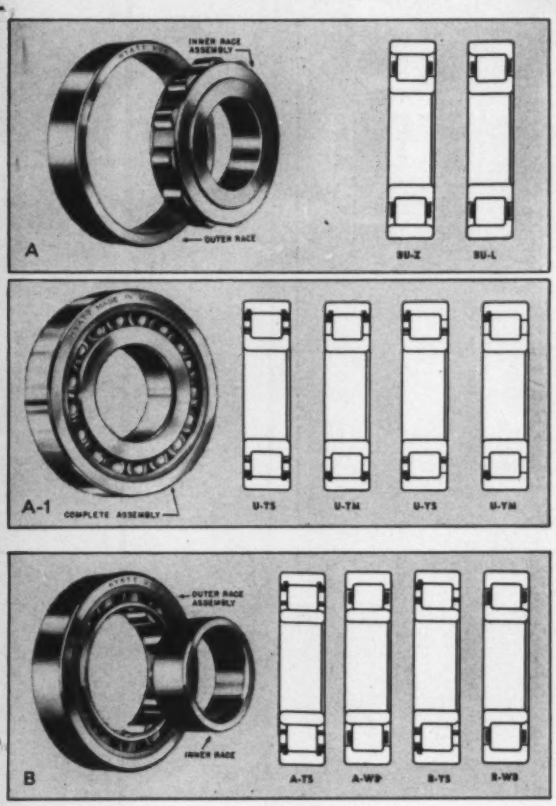
B. Cutaway views of HYATT Hy-Load separable inner race types.

C. Typical transmission application: Pilot bearing is BU-Z type without outer race, operating directly on hardened and ground gear bore, and an A-TS with inner race omitted operating directly on the shaft.



LINE FOR COSTS...PERFORMANCE

SEPARABLE RACE ROLLER BEARINGS with INTERCHANGEABLE PARTS



Take a look at some typical Hyatt bearing values!

Notice the built-in *versatility* of the various bearing types. Separable race roller bearings—with interchangeable parts—encourage improved product design because they are adaptable to highly individual and unique applications.

Notice the *space-saving* characteristics and the *higher radial load-carrying capacity* of Hyatt separable inner race types. Notice the quality construction, easy maintenance and installation of this Hyatt sample. All this can mean important cost reductions for you!

Now make note of this: in addition to the many typical Hyatt advantages which are apparent at left . . . Hyatt offers, too, the very tangible talent of the Hyatt Sales Engineer—a valuable *working partner* on any product team. For he multiplies Hyatt's obvious advantages of versatility, performance and lower cost with an unbeatable asset for product success—application experience and know-how of the most complete cylindrical bearing line in the industry!

Pick up the phone the next time you want to review your bearing applications—for an overall production or performance advantage for your product. Call your nearest HYATT sales office.

You'll find the best roller bearing engineers anywhere at the other end of the line.

HARRISON, N. J.
HUmbolt 4-4000

CHICAGO
HArrison 7-8277

PITTSBURGH
ATlantic 1-2927

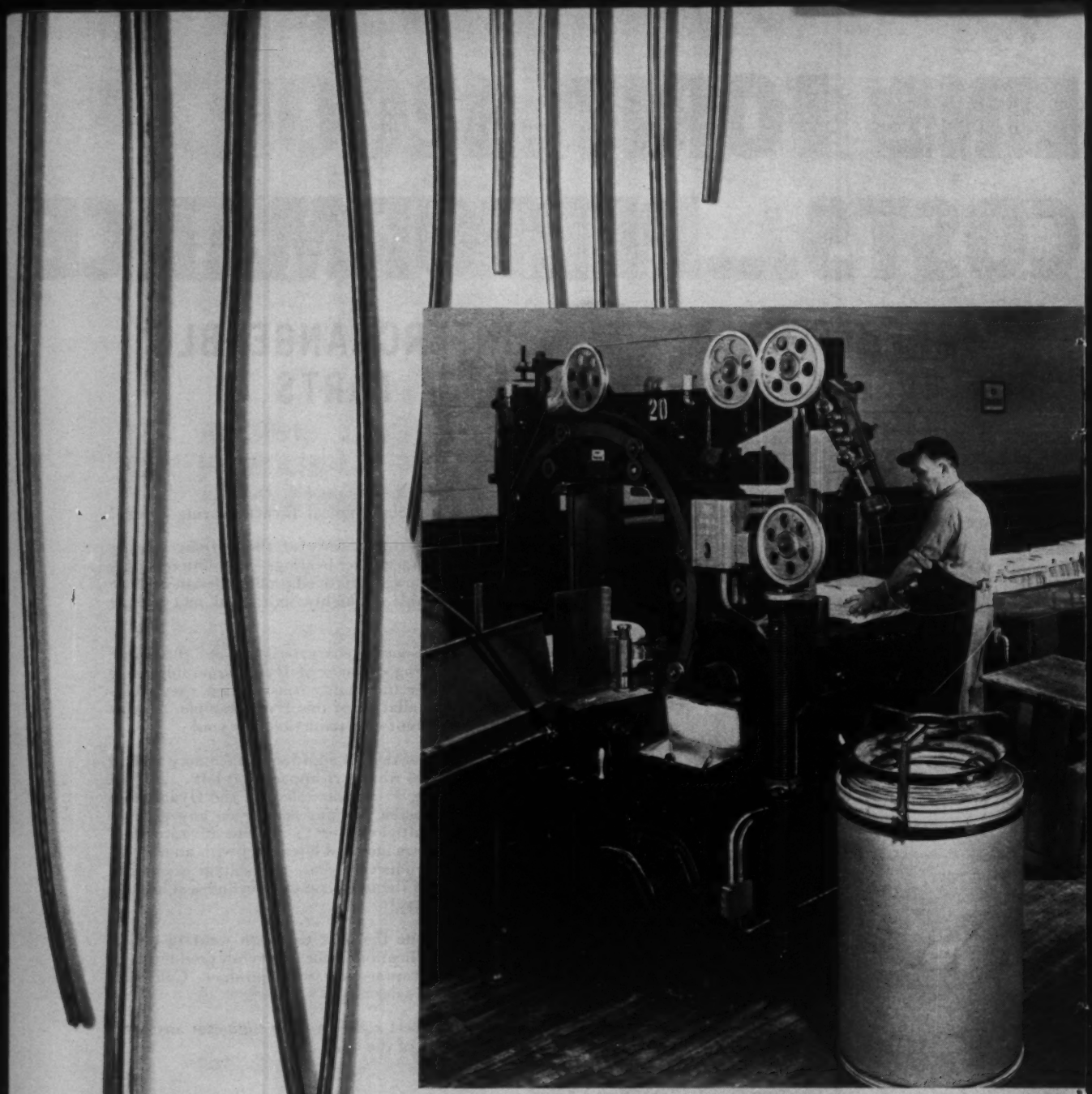
DETROIT
TRinity 3-7200

OAKLAND, CALIFORNIA
TWin Oaks 3-5362

HYATT HY-ROLL BEARINGS FOR MODERN INDUSTRY

IN ROLLER BEARINGS, HYATT IS THE WORD FOR GM RELIABILITY

HYATT BEARINGS DIVISION • GENERAL MOTORS CORPORATION • HARRISON, NEW JERSEY



"Next to paper and ink, tying wire is our most important purchase," says Chicago *TRIBUNE* management . . . clear proof that the *TRIBUNE's* use of Republic Wire for automatic bundling of newspapers is based on preference and specification. Wire used is soft galvanized, tough, yet easy forming—perfectly suited to fast handling in this publisher's automatic wire tying machines.

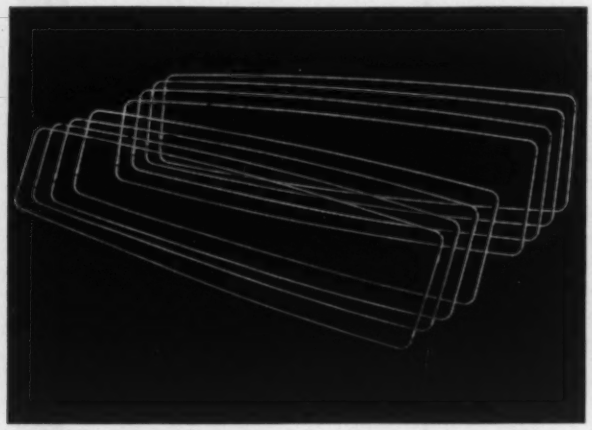
Steel

Strong
Modern
Dependable

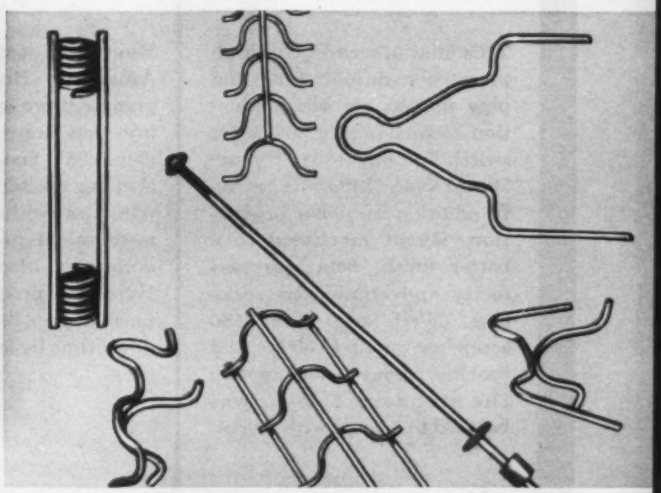
WIRE? WRITE, OR PHONE REPUBLIC

Republic has a reputation for solving wire worries. Rely on it. Talk to a Republic Wire Metallurgist—a man who knows and *understands* industry's varying needs for tensile, elongation, flow and formability. His experience, much of it gained by working on the scene with manufacturers like yourself, is backed by skill at the manufacturing level, plus undivided quality responsibility. Adherence to your specifications is under full Republic control, from ore selection to your plant . . . assuring that the wire you get will consistently meet your specific requirements.

Republic Wire Metallurgists can be called in at any time, on any problem of wire selection, application, or processing . . . *without obligation.* Wire? Write or call Republic, now.



B-W MANUFACTURERS, INC., former choice of wire for these popular trouser creasers lost its galvanized coating when flattened and bent to form the four right angles. Republic Wire Metallurgists recommended Republic *Electro-Galvanized* Wire. Result—profitable, perfect production ever since. Electro-Galvanizing electrically deposits pure zinc particles on the wire in deep uniform layers—permanently bonded and *tough*—yet pliable enough to permit tying the wire in knots without cracking the zinc coating!



MEADOW STEEL PRODUCTS, INC., keeps prices competitive on masonry construction accessories with adaptable Republic Manufacturers' Wire. More than 20 different parts are made from only a few types of wire, lowering inventory and material costs, and greatly simplifying production.

REPUBLIC STEEL

REPUBLIC HAS THE FEEL FOR MODERN STEEL

SEE OUR EXHIBIT AT THE
1961 DETROIT METAL SHOW
OCT. 23-27

THE EXPOSITION OF MATERIALS & PROCESS ENGINEERING

REPUBLIC STEEL CORPORATION
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1441 REPUBLIC BUILDING • CLEVELAND 1, OHIO

Please send information on the following kinds of Republic Wire:

- ☐ Manufacturers' Coarse Wire
- ☐ Spring Wire
- ☐ Screw Wire
- ☐ Rivet Wire
- ☐ Heading Wire
- ☐ Have a Republic Wire Metallurgist call

Name_____ Title_____

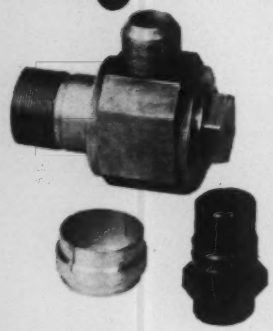
Company_____

Address_____

City_____ Zone____ State_____

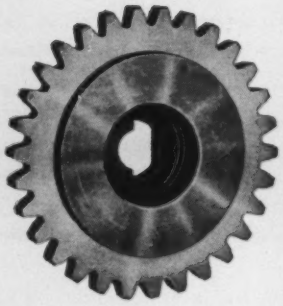
REPORTS ON RYCUT

world's fastest machining alloy steels in their carbon ranges



CUTS PRODUCTION COST 50% for Flodar Corp.

This manufacturer of high pressure hydraulic tube and pipe fittings reports production cost savings of 50% after switching from 4150 to Rycut® 50 and from 4140 to Rycut 40. In addition to higher production, Rycut machined to a better finish, held size perfectly and eliminated scrap loss. (With 4140 and 4150 scrap loss ran up to 30%.) And tool life, from 1 to 3 hours with the standard alloys, was boosted to 8 hours with Rycut.



MACHINES 35% FASTER for American Bosch

Rycut 40 was selected by American Bosch for this plunger drive gear for a diesel injection pump because it machines 35% faster than 4140—keeping machining costs at a minimum without sacrifice of mechanical properties. The company also found that Rycut 40 produced a better finish than 4140 and reduced down time by lengthening tool life.

BOOSTS SPROCKET PRODUCTION for McCulloch Corp.

These are the results obtained at McCulloch Corporation when they switched from non-leaded alloy to Rycut 40 for chain saw sprockets. Turning, forming, reaming and drilling operations: hourly production rate raised from 68 to 100 pieces—tool life lengthened from 3½ to 5 hours. Hobbing machine operations: hourly production raised from 43 to 65 pieces—tool life lengthened from 3916 parts per tool to 5874.

Rycut is available in a wide range of analyses: Rycut 20 is a case carburizing, oil hardening steel, with balanced composition. Rycut 40 annealed attains greatly varied strength and toughness, depending on heat treatment, making it suitable for an unusually wide range of applications. Rycut 50 annealed may be preferred (to Rycut 40) for parts with large mass or applications requiring higher mechanical properties. Rycut Heat Treated, stress relieved, assures uniform properties and machinability—carbon content is matched to bar size. Call Ryerson for any alloy requirement—and get top technical help, too.

RYERSON METALOGICS

JOSEPH T. RYERSON & SON, INC., MEMBER OF THE INLAND STEEL FAMILY

STEEL · ALUMINUM · PLASTICS · METALWORKING MACHINERY

"Job Security Depends on Profits"—Arthur B. Homer

"Investments in research and better production facilities are the only way in which job security and job opportunities can be created," said Arthur B. Homer, chairman, Bethlehem Steel Co., at the dedication of the $25 million Homer Research Laboratories last week in Bethlehem, Pa. "Security and progress depend on profits," he pointed out. A great deal of concern has been expressed about steel prices. "It would be encouraging to see evidence of equal concern for profits."

Capital Outlays in '62 to Equal '57 Record

New plant and equipment expenditures may reach a $35.9 billion annual rate in the fourth quarter, says Hickman Price Jr., assistant secretary of commerce. And capital outlays may reach $37 billion for 1962, equaling the previous record set in 1957. "But it will have taken five years just to achieve the previous high," he adds. "We should be surpassing it." Next year should see a GNP of $565 billion, Mr. Price told the Cleveland tf Club for advertising salesmen.

Pressures on Metalworking's Prices Mount

Despite all the pressures from government, foreign and domestic competition, and customers—prices are creeping upward. A spotcheck of metalworking by STEEL's editors showed: Thirty per cent have already boosted prices; 60 per cent plan to announce increases in the next few months. Nearly 75 per cent, including many who have already upped prices, say they'll pass along any increases the steel industry puts through. For the reasons why pricing is metalworking's No. 1 headache, see Page 75.

Retail Sales Slipped in September

Sales of retail stores declined less than 1 per cent in September, reports the Commerce Department. During August, they rose 1 per cent above July's. Durable goods sales were up 1 per cent from the August level but 4 per cent short of the September, 1960, level.

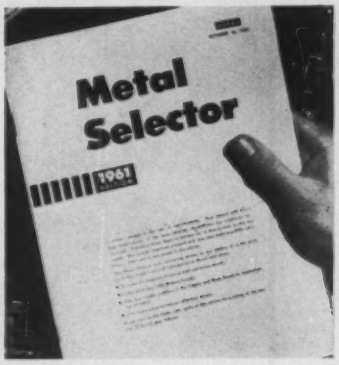
Economic Expansion Must Be Orderly, Warns Professor

Failure to keep our economic expansion on an orderly, vigorous basis beyond the next few months could lead to another business downturn, forecasts Paul W. McCracken, University of Michigan School of Business Adminis-

tration. Speaking to the National Consumer Finance Association, Professor McCracken urged greater awareness of the "blunt and painful truth" that the flow of U. S. dollars to the rest of the world should be cut down, thus strengthening our international balance of payments. To avoid price inflation, says Professor McCracken, the Federal Reserve should establish policies producing reasonably full employment without a disorderly boom. He also asks for a surplus in the fiscal 1963 federal budget and a tax hike if total government expenditures go much over $90 billion.

New Alloys Star in '61 Metal Selector

The pace of change in metals and metalworking is pointed up by the 1400 revisions required to bring STEEL's 1960 edition of its Metal Selector up to date. In the 1961 version, a section on refractory metals appears for the first time, and new Copper & Brass Research Association numbers designate the copper alloys. The selector (Pages 117-148) covers a broad range of ferrous and nonferrous metals and listings of their compositions, applications, and properties.



U. S. Opportunities in Canadian Metalworking

Profit opportunities in Canada's metalworking industry are pinpointed in a report by the Ontario Department of Commerce & Development. It tells how U. S. firms can establish manufacturing agreements with the more than 750 Canadian firms seeking such arrangements, lists Canadian export opportunities in the U. S., and points out "fabrication gaps" in Canadian metalworking—where home manufacture might reduce dependence on imports. (Write Box M, Suite 1307, 680 Fifth Ave., New York 19, N. Y.)

Exports Balance Operations, Keep Prices Down

A high level of export and foreign licensing activity often permits equipment builders to hold down prices to domestic buyers, points out John R. Bartizal, president, Clearing Div., U. S. Industries. Reason: Such activities help balance out operations and spread costs over a wider base. Clearing, which is getting ready to ship a new automated press line (for auto fenders) to Japan, reports that foreign sales are accounting for 62 per cent of its current orders.

India and Pakistan Have 11 Million More People

Official world population jumped by 11 million in one swoop when the returns from the 1961 India and Pakistan censuses were announced. Population estimates for 1960 had missed the count by 7 million in India and 4 million in Pakistan. The Population Reference Bureau, Washington, says India has a net natural increase in population of 1.97 per cent annually and "there is no reason to believe Pakistan's rate is any less rapid."

Workers Forego General Wage Hike

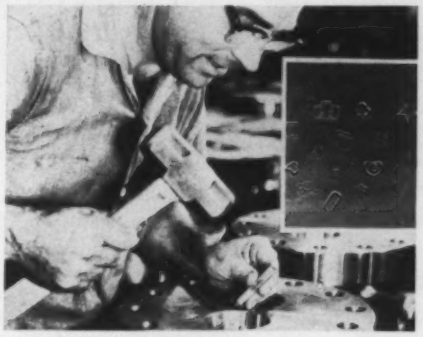
General wage increases were recently passed up by employees of chemical and metallurgical industries in Niagara Falls, N. Y., to offset rising costs and foreign competition. Among the companies negotiating contracts without pay increases were: Union Carbide Chemicals, Union Carbide Metals, Great Lakes Carbon, International Minerals, National Carbon, Olin, Titanium, Pittsburgh Metallurgical, Stauffer General Abrasive, Du Pont, and Hooker Chemical.

More Satisfaction Is Being Guaranteed

Manufacturers are trending toward longer warranties and such bonus extras as service, shows a study by Lippincott & Margulies Inc., industrial designers. Spurred by Detroit's 12,000 mile or one year guarantees, appliance makers in particular are following the trend—some even include the cost of service labor. To enhance customer relations, GE has dealers present warranty certificates to customers instead of shipping them with the product.

Workers Are Proud to Brand Their Work

"Punchers" put their brands on oil field valves instead of cattle at W-K-M Div., Missouri City, Tex., ACF Industries. Craftsmen use metal stencils to identify their work on close tolerance operations, and they're proud of "no-comeback" records of their private brands. More than 200 marks are often punched on complex valves.



U. K. Membership in Common Market Would Benefit U. S.

Britain's entry into the Common Market should increase the European demand for U. S. capital goods, says Undersecretary of Commerce Edward Gudeman. As soon as British membership is a certainty, both British and Common Market firms will have strong incentives to make their protected enterprises as competitive as possible, he explains. In the long run, the stimulated growth of the European economy would benefit U. S. exports as a whole.

Gas Appliance Sales Show Strong Uptrend

If improvements in gas appliance sales in August and September continue through the year, they will wipe out the effects of the recession earlier in the year, says William G. Hamilton Jr., president, Gas Appliance Manufacturers Association. "In fact," he adds, "it now looks as though several of our product divisions will ring up records in 1961."

Containerization Will Boost Trailer Industry

"The trailer industry is a $500 million a year industry. With full utilization of the containerization principle, it can be five times that much. It won't

STEEL the Metalworking Weekly

October 16, 1961 Vol. 149 No. 16

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Editorial index available semiannually.

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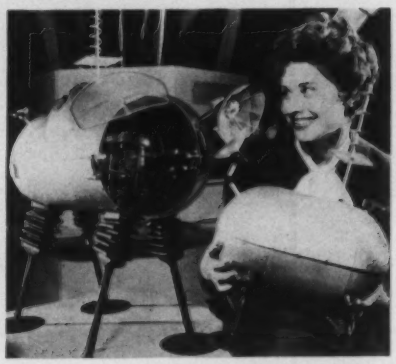
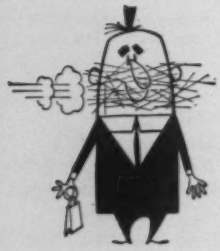
come overnight, but it is in the foreseeable future," declares Robert D. Hill, vice president-financial, Fruehauf Trailer Co., Detroit. He says the standard over-the-road trailer will continue to be Fruehauf's bread and butter product for about three more years, but big advances will come from the container field.

RCA Proposes Lunar Locomotion Devices

Two lunar rover models get acquainted at the American Rocket Society conclave in New York City. "Porkie" (in the young lady's hands) and "Dumbo" are being developed as locomotive devices for exploring the moon's barren surface. Creator of these imaginative, animal-like mechanisms is the Astro-Electronics Div. of RCA's Defense Electronic Products.



Straws in the Wind



About 1 in 3 U. S. manufacturing firms engaged in overseas operations last year used foreign based subsidiaries, says the National Industrial Conference Board . . . The Labor Department reports that nonfarm employment was 53,930,000 in the month ended mid-September—a record level for any month . . . Thirty of the nation's top economists have agreed to serve as consultants to the Treasury Department . . . A survey by the American Society for Engineering Education lists 11,000 research projects in progress at 121 engineering colleges. Expenditures last year: $180 million . . . M. A. Hanna Co., Cleveland, plans to reorganize its management and ownership. Plans include disposing of direct activities—mining, shipping, dock operations—and the formation of a closed-end investment company with assets of about $500 million. Stockholders will vote on the plan Oct. 31. . . . September ingot production increased to 8,904,000 tons compared with the revised figure of 8,660,527 tons in the preceding month, AISI reports. That brings preliminary totals for the third quarter to 25,656,485 tons and for the first nine months to 70,515,145 tons.

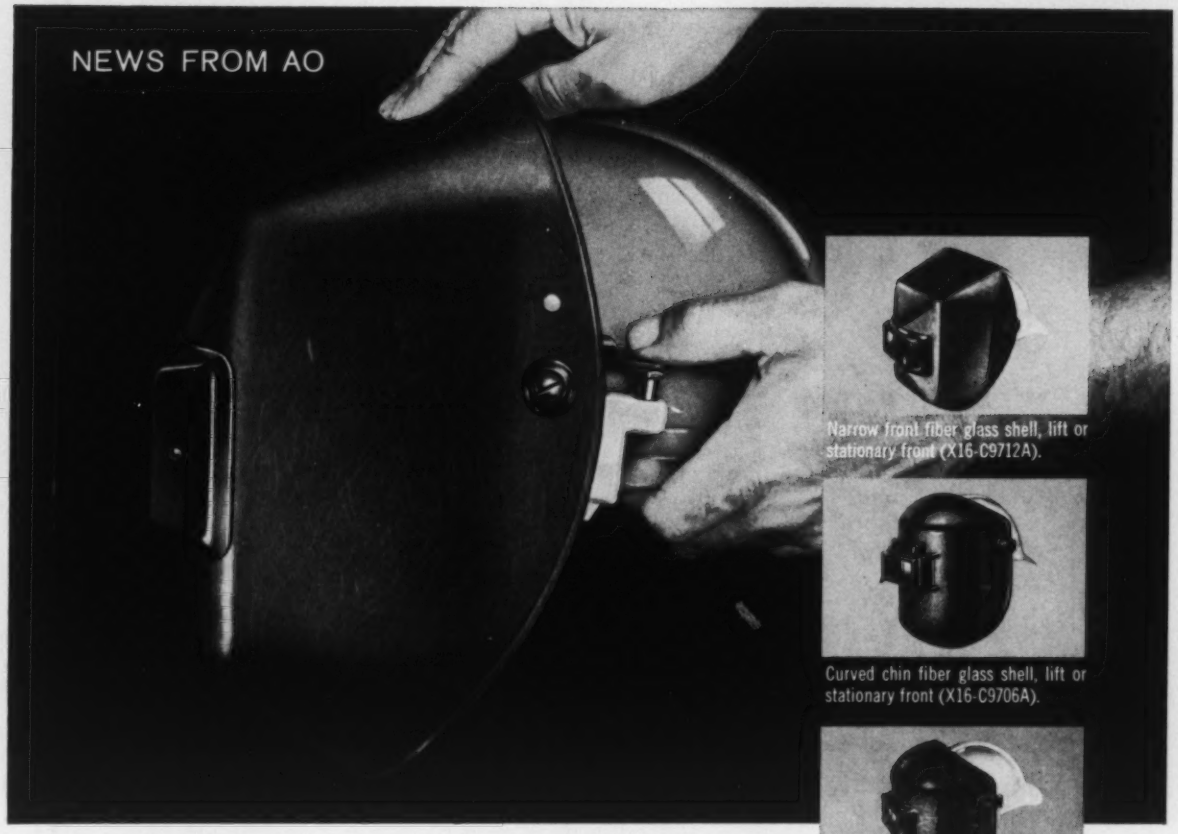
Metalworking Pulse

The Business Trend: After setting the year's high of 172 (1947-49=100), STEEL's industrial production index slipped 3 points in the week ended Oct. 7 as the result of the strike at Ford Motor Co. It is likely to peak again when Ford gets back in full production. **Autos:** The Ford strike counterbalanced the increase in production at General Motors Corp. following settlement of its labor dispute. **Steel:** Ingot output is expected to rise following two weekly declines.

- **INDUSTRIAL PRODUCTION INDEX**
  (1947-49 = 100)
  Week ended Oct. 7 .... 169†
  Year ago 151
  Details on Page 95
- **PASSENGER CAR OUTPUT (UNITS)**
  Week ended Oct. 14 . 105,000*
  Year ago 144,056
  Details on Page 92
- **STEEL INGOT OUTPUT (TONS)**
  Week ended Oct. 14 ... 2,080*
  Week ago 1,579
  Details on Page 199

†Preliminary. *Estimated.

NEWS FROM AO

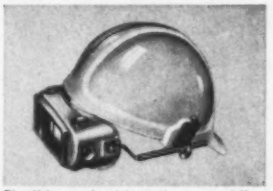


Narrow front fiber glass shell, lift or stationary front (X16-C9712A).

Curved chin fiber glass shell, lift or stationary front (X16-C9706A).

Curved chin fiber glass shell, heat-reflective coating, lift or stationary front (X16-C9702WA).

Straight front fiber glass shell, lift or stationary front (X16-C9602A).



Flexible mask with stationary welding plate (X16-C488).

Welders' coverglas goggles (X16-C329B).

Now... One Easy-to-Use Clip Fastens Any of These Attachments To an AO Safety Cap

You can use any of these accessories with regular AO Dura-Guard safety caps . . . all you need is a pair of AO's simple X30 clip-on attachment holders. Molded of nylon, they slide easily over the side brim and are secured by nylon set screws which hold them tight. No drilling. No holes. No need to stock caps with attachments. Just apply clips to regular stock of caps.

Choose from 10 welding helmet models (both fiber glass and vulcanized fiber, lift or stationary fronts), flexible mask welding goggles, and welders' and chippers' coverglas goggles. All are quickly and simply attached to the Dura-Guard safety cap by slipping the attachment post into the hole provided. It locks securely into position, can be detached in seconds when you want to remove it.

Because they are all-plastic, the X30 clips insulate metal attachment parts, help retain the Dura-Guard cap's dielectric properties. You can get complete details on all these new accessory helmets and goggles by contacting your AO Safety Products Representative or writing direct.

Your Surest Protection . . . AO SURE-GUARD Products

American Optical COMPANY

SAFETY PRODUCTS DIVISION • SOUTHBRIDGE, MASSACHUSETTS

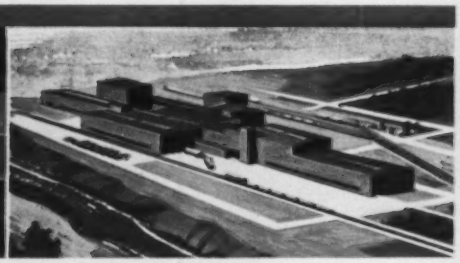
NATIONAL STEEL'S FAST NEW COLOR LINE

From this new automated finishing line at our Stran-Steel Division —the most advanced of its kind—stream the colorful pre-coated steel panels for our handsome Stran-Steel pre-engineered steel buildings. Stimulated by our pioneering of color, progressive designs and modern production techniques, demand for these modern buildings is flourishing. And this new 600-ft. color finishing line is providing effectively protected, uniformly color-coated steel building panels to meet the soaring demand more efficiently than ever.

Starting with zinc-coated coils that are first roll-formed, then cut into panels, our Stran-Steel Division's new line automatically processes the panels with a bond coat, an oven curing, multiple color coats and a second oven treatment via a unique 4-zone installation. Precision controls linked by twenty miles of wiring unerringly maintain the stringent specifications for paint pressures, oven temperatures and conveyor speeds. The result: Steel panels in any of ten long-lasting and attractive color finishes—all at a price per square foot that's just slightly higher than for galvanized steel alone.

FIVE OTHER MAJOR STEPS TO FURTHER PROGRESS

AT GREAT LAKES STEEL in Detroit, the computer-controlled and operated 80" Mill of the Future—fastest, most powerful hot-strip mill in the world—will provide more and better automobile body sheets.



AT MIDWEST STEEL near Chicago, the most modern and efficient steel finishing plant in existence is providing industry with the finest quality galvanized sheets, tin plate and, soon, hot- and cold-rolled sheets.

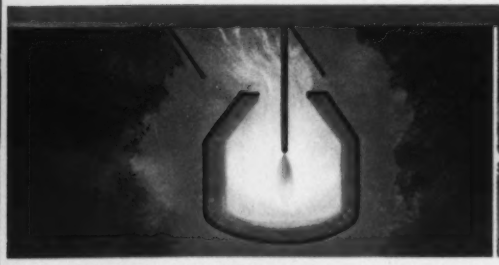
FOR PRE-COATED STRAN-STEEL BUILDINGS

This new finishing facility is one step in a program of progress throughout all divisions in which National Steel is investing well over $300,000,000. Among the far-ranging benefits: greater efficiency and stability throughout our operations; more secure jobs for our employees; more and better steel for our customers; and better values for you, the ultimate consumer of the million and one products made of steel. Other phases of this program will swing into action soon. And we will be bringing you news about them, too.

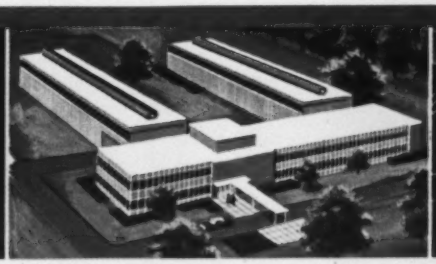
NATIONAL STEEL CORPORATION, PITTSBURGH, PA.

SUBSIDIARIES AND DIVISIONS:

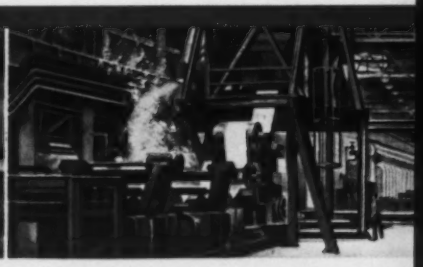
GREAT LAKES STEEL • WEIRTON STEEL • MIDWEST STEEL • STRAN-STEEL • ENAMELSTRIP • HANNA FURNACE • NATIONAL STEEL PRODUCTS



NEW BASIC OXYGEN FURNACES at Great Lakes Steel. Construction has started on two basic oxygen furnaces—to be the largest ever built—which will add new capacity and greater efficiency.



OUR NEW RESEARCH CENTER will be National Steel's headquarters for the expanded, continuing exploration of new and better raw materials, facilities, manufacturing processes and products of steel.



AT WEIRTON STEEL in Weirton, W. Va., new and improved facilities throughout this division increase the production and improve the quality of Weirton's tin plate, galvanized sheets and cold-rolled sheets.

all sawing requirements point to Oliver

PRODUCTION + QUALITY WITH

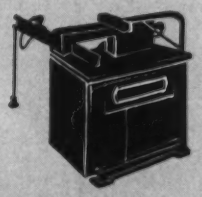
Oliver

EQUALS PROFITS TO YOU

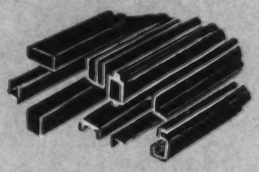
Production requirements are easily met
on an Oliver saw.
Oliver has the saw to handle
your cutting problem.
All inquiries promptly handled.

OLIVER MACHINERY COMPANY

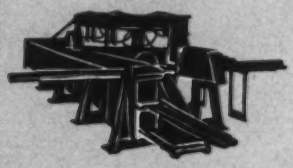
Grand Rapids 2, Michigan



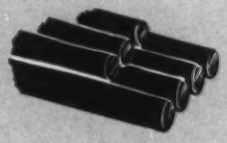
Automatic Cutoff Saw



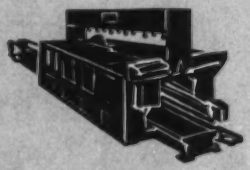
Saws for aluminum extrusions



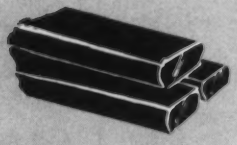
Non-ferrous Plate Saw



Saws for aluminum billets

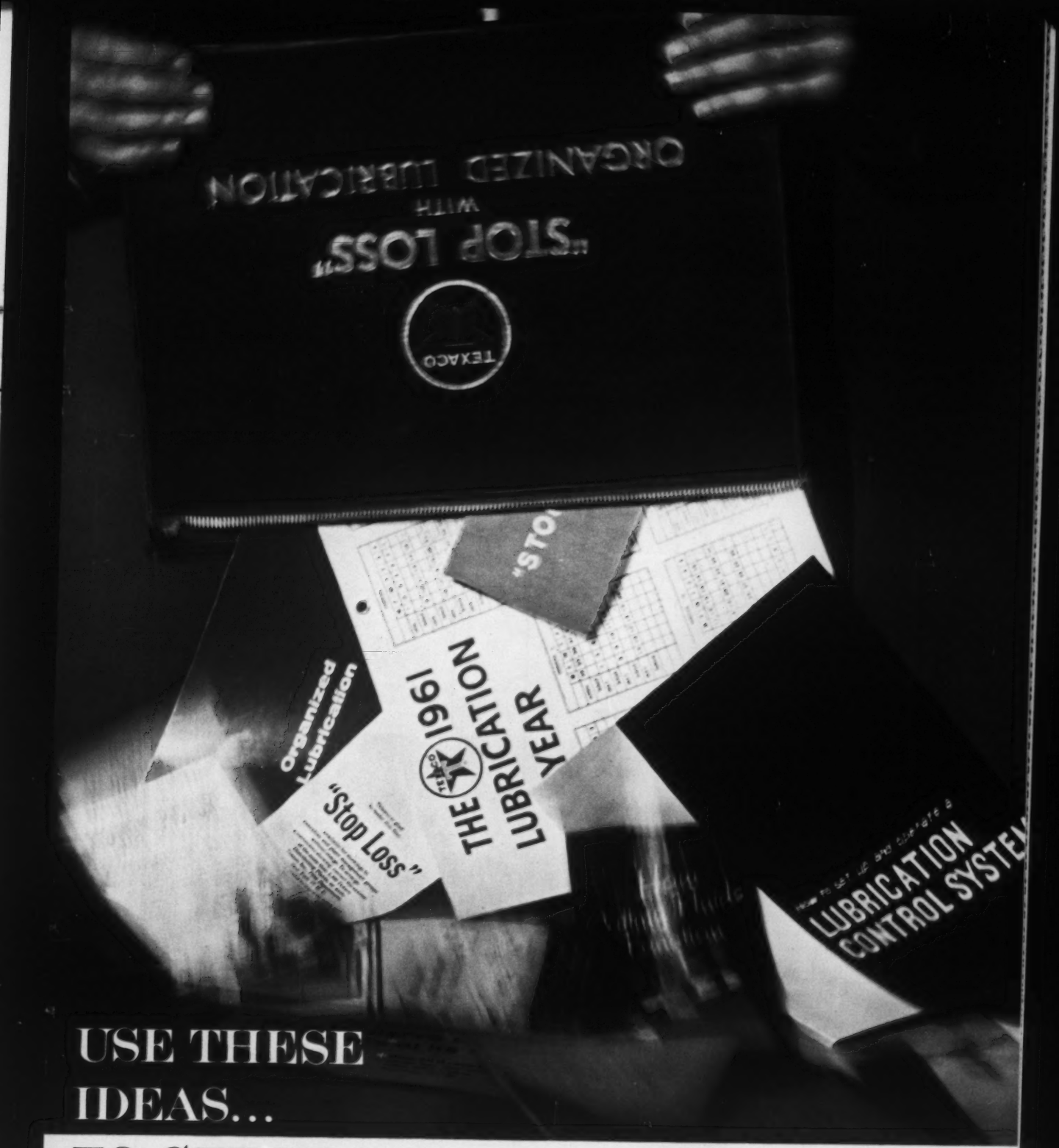


Steel Plate Saw



Saws for Copper billets

Hydraulic Straightline Saw



USE THESE IDEAS...

TO GET UP TO AN EXTRA 4% NET PROFIT

Out of the Texaco man's briefcase comes a wealth of ideas for cost control through organized lubrication—Texaco's "Stop Loss" Program. Managers in many industries are already using these plans to reduce losses in three important areas: production, maintenance and purchasing. Their savings go directly into profits—the average is a 4% gain in their net. Get the facts. Write for our informative folder: "How to Starve a Scrap Pile." **TEXACO** INC.,
135 East 42nd Street, New York 17, N. Y. Dept. S-192

TEXACO

NOW

New 12B2R Inline Screw Driver.

new, powerful, lightweight line of reversible air tools

Here's a new line of handy, lightweight, *reversible* air tools from Gardner-Denver—designed to keep your production lines moving at top efficiency. Screw drivers, nut setters—inline and angle types—are available with a complete selection of interchangeable attachments.

Powerful air motor. It's the motor that makes the big difference in these tools. Compact design houses more power, higher speed . . . provides lighter weight, lower noise level than ever before.

Reversibility. Saves valuable man-hours—assures accurate driving and setting—prevents sending assemblies to repair stations. Permits tightening both right- and left-hand threaded fasteners. Entire line also available in non-reversible models.

For famous Gardner-Denver versatility and interchangeability, get all the facts on this exciting new line of air tools. See your Gardner-Denver air tool specialist, or write for bulletins.

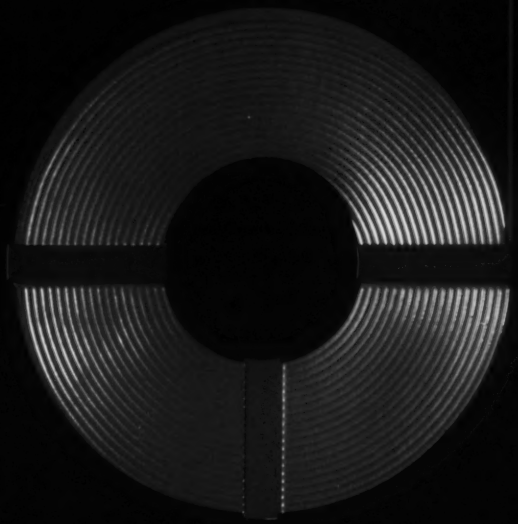
New 11B2 Series Inline Drill. New line also includes angle drills, ratchet wrenches, tappers.

EQUIPMENT TODAY FOR THE CHALLENGE OF TOMORROW

GARDNER - DENVER

Gardner-Denver Company, Quincy, Illinois—Offices in principal U.S., Canadian and Mexican cities
In Canada: Gardner-Denver Company (Canada), Ltd., 14 Curity Ave., Toronto 16, Ontario

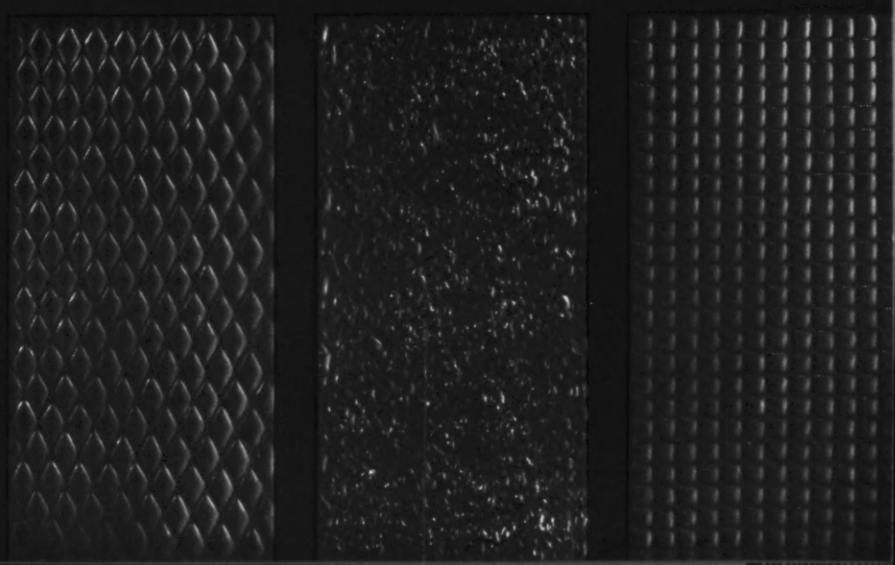
International: Gardner-Denver International Division, 233 Broadway, New York 7, N. Y.
International Offices: Buenos Aires, Argentina; Artarmon, N.S.W. Australia; Brussels, Belgium; Rio de Janeiro, Brazil; Santiago, Chile; Barranquilla, Colombia; Lima, Peru; Ndola, N. Rhodesia; Salisbury, S. Rhodesia; Johannesburg, Transvaal

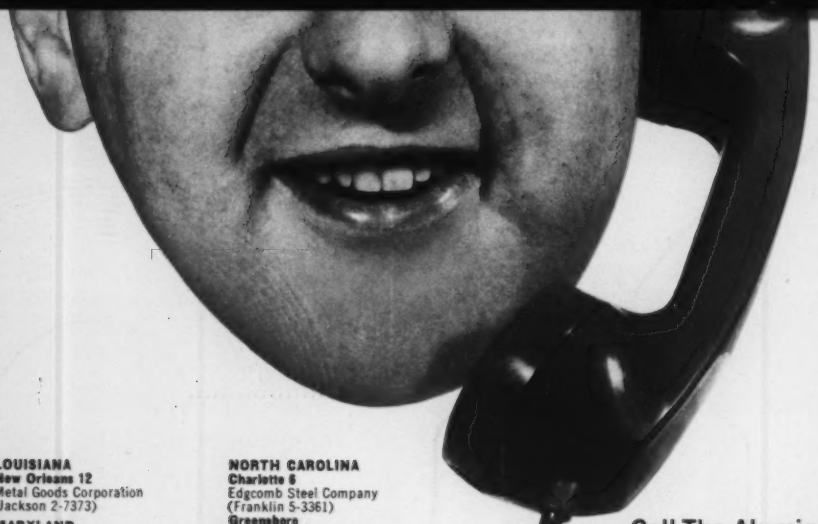


Widest Range from Any Distributor Source. Calling on your local Alcoa distributor for aluminum in all its forms is like having an Alcoa plant next door. Nobody else stocks as much sheet and plate; wire, rod and bar; tube and pipe; and extruded shapes in as many sizes, alloys and finishes. Nobody else can respond as quickly to your call for metal or technical advice.

ALCOA ALUMINUM

DISTRIBUTED NATIONALLY





ALABAMA
Birmingham 5
Hinkle Supply Company, Inc.
(Fairfax 2-4541)
The J. M. Tull Metal & Supply Co., Inc.
(Fairfax 3-1612)
ARIZONA
Phoenix
Ducommun Metals & Supply Co.
(Bridge 5-4471)
Pacific Metals Company, Ltd.
(Alpine 8-7821)
CALIFORNIA
Berkeley 10
Ducommun Metals & Supply Co.
(Thornwall 1-1820)
Los Angeles 59
Benjamin Metals Company
(Rod & Bar) (Nevada 6-0611)
Los Angeles 54
Ducommun Metals & Supply Co.
(Ludlow 8-0161)
Los Angeles 22
Pacific Metals Company, Ltd.
(Raymond 3-5431)
Los Angeles 22
Tubesales (Tube & Pipe)
(Raymond 3-7781)
San Diego
Ducommun Metals & Supply Co.
(Gridley 7-3141)
San Diego 1
Pacific Metals Company, Ltd.
(Belmont 4-3253)
San Francisco 7
Pacific Metals Company, Ltd.
(Underhill 3-5600)
COLORADO
Denver 16
Marsh Steel & Aluminum Co.
(Keystone 4-1241)
Denver 16
Metal Goods Corporation
(Dudley 8-4141)
CONNECTICUT
Milford
Edgcomb Steel of New England, Inc.
(Trinity 4-1631)
Windsor
Whitehead Metals, Inc.
(Murdock 8-4921)
FLORIDA
Jacksonville 5
The J. M. Tull Metal & Supply Co., Inc.
(Evergreen 7-5561)
Miami
The J. M. Tull Metal & Supply Co., Inc.
(Oxford 6-0150)
Tampa 10
The J. M. Tull Metal & Supply Co., Inc.
(3-6741)
GEORGIA
Atlanta 2
The J. M. Tull Metal & Supply Co., Inc.
(Jackson 5-3871)
HAWAII
Honolulu 14
Aluminum Products Hawaii, Ltd.
(94-861)
IDAHO
Boise
Pacific Metal Company (3-6468)
ILLINOIS
Chicago 80
Central Steel and Wire Company
(Republic 7-3000)
Chicago 80
The Corey Steel Company
(Bishop 2-3000)
Chicago 23
Steel Sales Corporation
(Bishop 7-7700)
INDIANA
Indianapolis 18
Steel Sales Co. of Indiana, Inc.
(Liberty 6-1535)
KANSAS
Wichita
Marsh Steel & Aluminum Co.
(Whitehall 2-3231)
KENTUCKY
Louisville 3
Williams and Company, Incorporated
(Juniper 3-7781)

LOUISIANA
New Orleans 12
Metal Goods Corporation
(Jackson 2-7373)
MARYLAND
Baltimore 7
Whitehead Metals, Inc.
(Windsor 4-2000)
MASSACHUSETTS
Boston 19
Eastern Metal Mill Products Co.
(Highlands 2-5900)
Cambridge 39
Whitehead Metals, Inc.
(Trowbridge 6-4680)
MICHIGAN
Detroit 12
Central Steel and Wire Company
(Twinbrook 2-3200)
Detroit (Hazel Park)
Meier Brass & Aluminum Co.
(Jordan 6-3902)
Detroit 10
Steel Sales Co. of Michigan
(Tyler 6-3000)
MINNESOTA
Minneapolis 13
Steel Sales Co. of Minnesota
(Sterling 1-4893)
MISSOURI
North Kansas City 16
Marsh Steel & Aluminum Co.
(Grand 1-3505)
North Kansas City 16
Metal Goods Corporation
(Grand 1-3516)
St. Louis 14
Metal Goods Corporation
(Harrison 7-1234)
St. Louis 10
Steel Sales Co. of Missouri, Inc.
(Prospect 1-5255)
NEW HAMPSHIRE
Nashua
Edgcomb Steel of New England, Inc.
(Tuxedo 3-7731)
NEW JERSEY
Elizabeth
Adam Metal Supply of New Jersey
(Flanders 1-2550)
Englewood
Tubesales (Tube & Pipe)
(Lowell 7-4400)
Harrison
Whitehead Metals, Inc.
(Humbolt 5-5900)
Hillside 5
Miller Steel and Aluminum
Division of Robert Campbell Co., Inc.
(Waverly 6-6000)
NEW YORK
Albany 1
Eastern Metals Warehouse, Inc.
(IV 9-3281)
Buffalo 17
Brace-Mueller-Huntley, Inc.
(TR 7-8700)
Buffalo 7
Whitehead Metals, Inc.
(TR 6-3100)
New York (Long Island City 1)
Adam Metal Supply
(Stilwell 6-7737)
New York (Brooklyn)
Strahs Aluminum Company, Inc.
(Browning 2-7000)
New York 14
Whitehead Metals, Inc.
(Watkins 4-1500)
Rochester 5
Adam Metal Supply of Rochester
(Locust 2-4260)
Rochester 1
Brace-Mueller-Huntley, Inc.
(Congress 6-6560)
Rochester 10
Whitehead Metals, Inc.
(Butler 8-2141)
Syracuse 1
Brace-Mueller-Huntley, Inc.
(Howard 3-3341)
Syracuse 1
Whitehead Metals, Inc.
(Howard 3-6241)

NORTH CAROLINA
Charlotte 6
Edgcomb Steel Company
(Franklin 5-3361)
Greensboro
Edgcomb Steel Company
(Broadway 5-8421)
OHIO
Cincinnati 14
Central Steel and Wire Company
(Avon 1-2230)
Cincinnati 37
Williams and Company, Incorporated
(Valley 1-5555)
Cleveland 28
A. M. Castle & Co.
(Axminster 2-7600)
Cleveland 14
Williams and Company, Incorporated
(Utah 1-5000)
Columbus 12
Williams and Company, Incorporated
(Axminster 4-1623)
Toledo 12
Williams and Company, Incorporated
(Greenwood 5-8861)
OKLAHOMA
Tulsa 13
Metal Goods Corporation
(Temple 6-2561)
OREGON
Portland 9
Pacific Metal Company
(Capitol 7-0693)
PENNSYLVANIA
Philadelphia 34
Edgcomb Steel Company
(Garfield 3-6300)
Philadelphia 33
Metal Supply Company
(Center 6-0220)
Philadelphia 40
Whitehead Metals, Inc.
(Baldwin 9-2323)
Pittsburgh 33
Williams and Company, Incorporated
(Cedar 1-8600)
York
Edgcomb Steel Company (47-1931)
RHODE ISLAND
Slatersville
Edgcomb Steel of New England, Inc.
(Poplar 7-0900)
SOUTH CAROLINA
Greenville
The J. M. Tull Metal & Supply Co., Inc.
(Cedar 3-8366)
TENNESSEE
Memphis 6
Metal Goods Corporation
(Whitehall 8-3407)
TEXAS
Dallas
McCormick Steel Company
(CH 7-3104)
Dallas 35
Metal Goods Corporation
(Fleetwood 1-3271)
Houston 1
McCormick Steel Company
(OR 2-6671)
Houston 1
Metal Goods Corporation
(Riverside 7-1110)
UTAH
Salt Lake City 1
Pacific Metals Company, Ltd.
(Davis 8-2222)
WASHINGTON
Seattle 8
Ducommun Metals & Supply Co.
(Parkway 5-1500)
Seattle 4
Pacific Metal Company (Main 2-6925)
Spokane 4
Pacific Metal Company
(Keystone 5-3681)
WISCONSIN
Milwaukee 1
Central Steel and Wire Company
(Humboldt 1-5000)
Milwaukee 9
Steel Sales Co. of Wisconsin
(Hilltop 2-2020)

Call The Aluminum Man . . . his stock's the most complete!

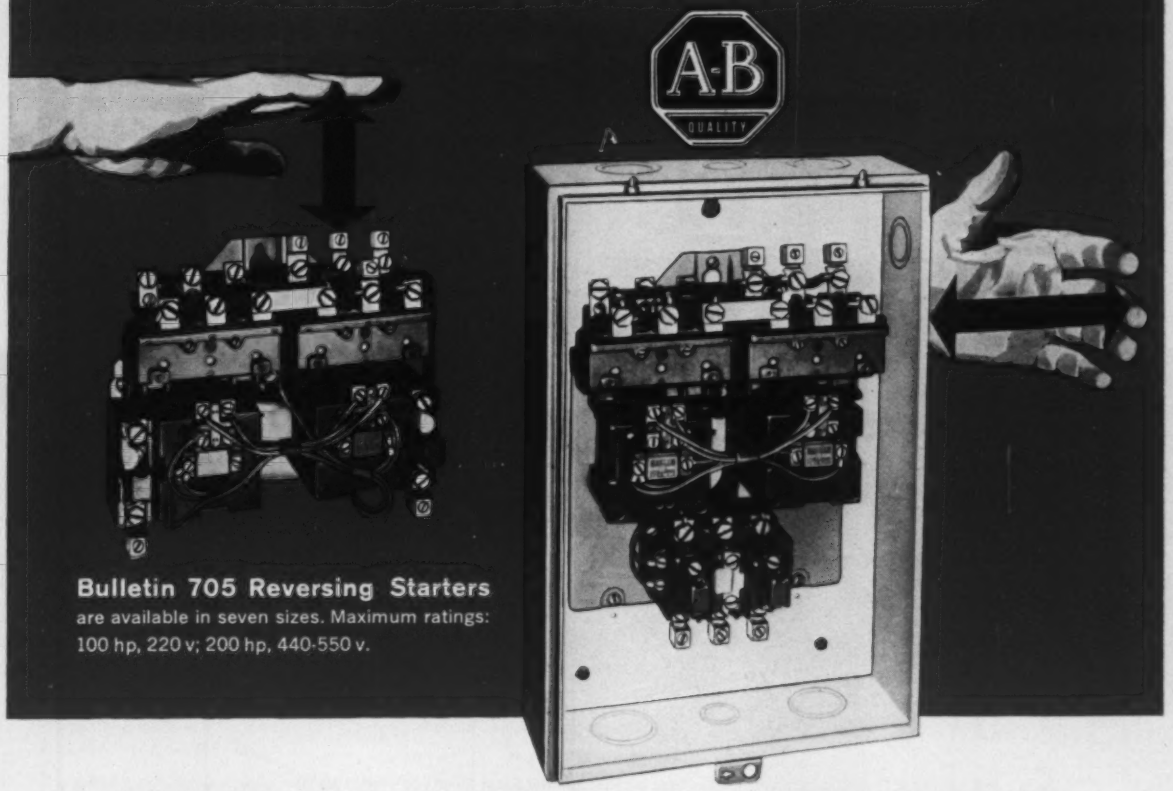
Your Alcoa distributor sales representative—*The Aluminum Man*—maintains a warehouse bulging with sheet and plate; tube and pipe; extruded shapes; wire, rod and bar. His stock represents the widest range of aluminum products available from any distributor source. He can arrange for them to be slit, sawed or sheared to your specifications—furnish technical advice you may need on alloy selection and fabrication techniques. He's your fastest supply line for aluminum in any form when you need it. Your nearest Alcoa distributor is listed on this page, so give him a call . . . soon. Aluminum Company of America, 845-X Alcoa Building, Pittsburgh 19, Pa.

ALCOA ALUMINUM

DISTRIBUTED NATIONALLY

Call *The Aluminum Man* . . . he's your Alcoa distributor sales representative

No Matter Where You Install Them—



Bulletin 705 Reversing Starters are available in seven sizes. Maximum ratings: 100 hp, 220 v; 200 hp, 440-550 v.

The New Allen-Bradley Reversing Starters are "Ideal" for the Application

Whether you're using the "open type" Bulletin 705 reversing starters in special panel mounting or as an enclosed device for mounting on a machine, the space you can save will surprise you—especially in the higher ratings! For instance, the open type construction is appreciably narrower than the older design. In the enclosed design—because the overload relays (either 2 or 3) are mounted as a "block" below the reversing switch, the cabinet is much narrower.

There is no denying that the new A-B Bulletin 705 reversing starter is the best "buy" on the market today. Rating for rating, the old reliable Bulletin 705 reversing switches can no longer be compared with their successors. While the simple one-moving-part solenoid principle of operation has been retained, the detail design and construction has been greatly improved. The result is *extra* life that assures almost unbelievable reliability.

The new, attractive enclosures add extra "eye appeal" to any installation. For full details, please write today for Publication 6100: Allen-Bradley Co., 1320 South Second Street, Milwaukee 4, Wisconsin.

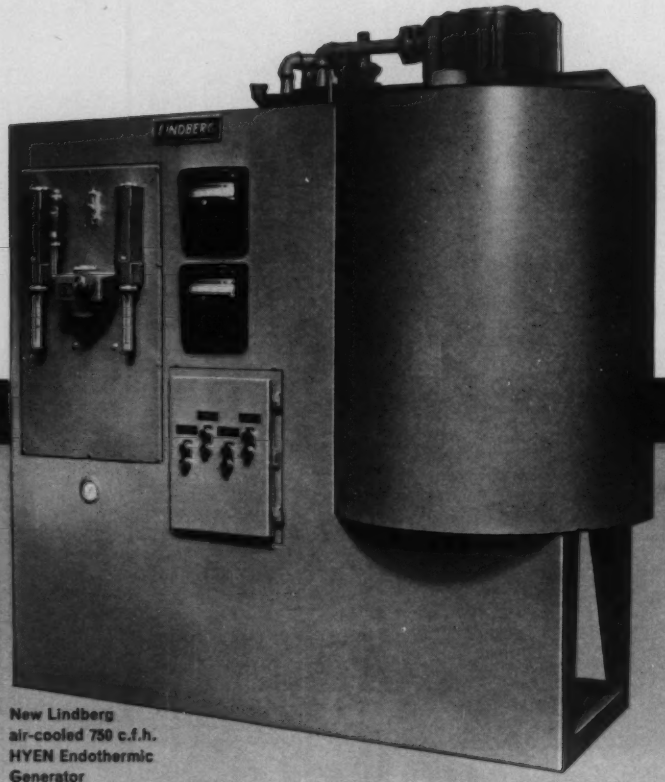
ALLEN-BRADLEY

Member of NEMA

QUALITY MOTOR CONTROL

There's one sure way

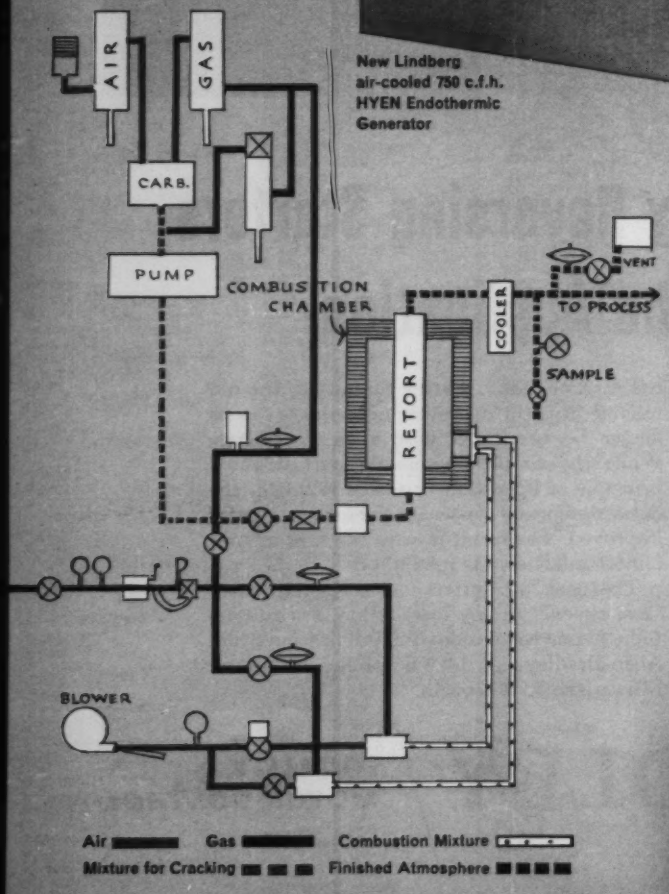
You'll see these brand-new Lindberg Generators at the Metal Show



New Lindberg air-cooled 750 c.f.h. HYEN Endothermic Generator

New Lindberg Model 200 HYAM Ammonia Dissociator

Schematic Flow Diagram of Lindberg HYEN Generator



To be shown for the first time are two Lindberg generators designed and engineered for improved efficiency and economy in the production of metallurgical atmospheres.

The new Lindberg HYEN ENDOTHERMIC GENERATOR is a fully automatic process for producing low cost protective atmospheres for bright hardening, bright annealing or bright brazing of steel totally free from decarburization or carburization. It will provide significant production economies, more precise operation and lowered maintenance costs. This new unit is *air-cooled*, eliminating the expense and trouble of water cooling systems. The HYEN Generator is available in 200, 500, 750, 1000 and 1500 c.f.h. capacities and larger sizes can be provided if desired.

The Lindberg HYAM AMMONIA DISSOCIATOR, Model 200, is a brand-new development offering a combination of efficiency, capacity and compactness never before available to industry. The unit requires *less than 2 square feet of floor space.* Operating at capacities up to 200 c.f.h., it is *guaranteed* to maintain or exceed 99.95% dissociation efficiency (at 150 c.f.h. 99.99% efficiency is guaranteed). It is particularly designed for pilot plant applications, research and development, where high purity of atmosphere is required.

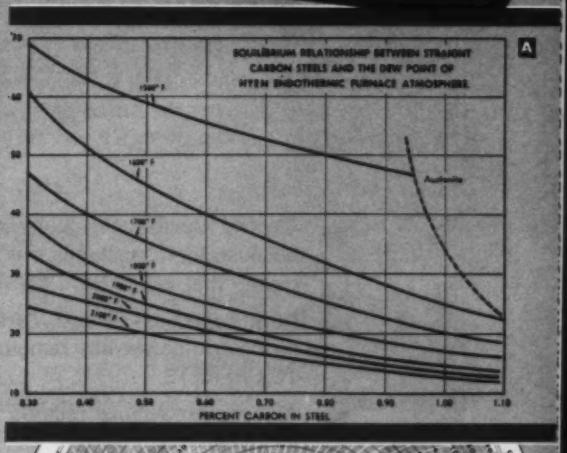
LINDBERG
heat for industry

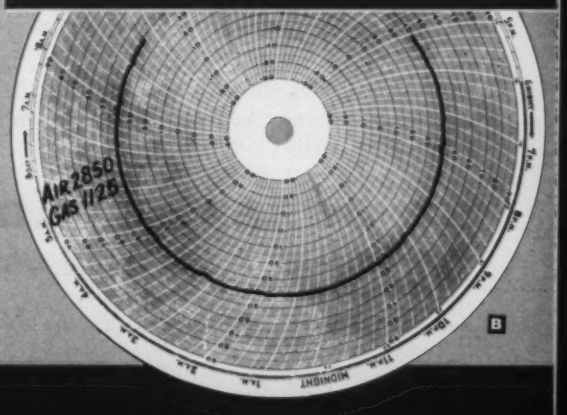
to get the right information on methods and equipment for producing and controlling

metallurgical atmospheres

Lindberg Carbotrol available for either dew-point or CO_2 infra-red control systems

A—Dew point equilibrium curves for use with Carbotrol have been established by Lindberg for types of steel and temperatures involved. B—Typical graph of Carbotrol performance. Note consistency of control.


A
EQUILIBRIUM RELATIONSHIP BETWEEN STRAIGHT CARBON STEELS AND THE DEW POINT OF HYEN ENDOTHERMIC FURNACE ATMOSPHERE
Austenite
PERCENT CARBON IN STEEL



Talk it over with Lindberg in Booth No. 706 at the Metal Show

Because of the importance of metallurgical atmospheres in metal working we are giving the subject major emphasis in our exhibit at the Metal Show. Visit us there and you'll be able to learn about all the latest developments in methods and equipment for producing and controlling these atmospheres. You'll find us well qualified to offer authoritative advice in this field because we've pioneered in it.

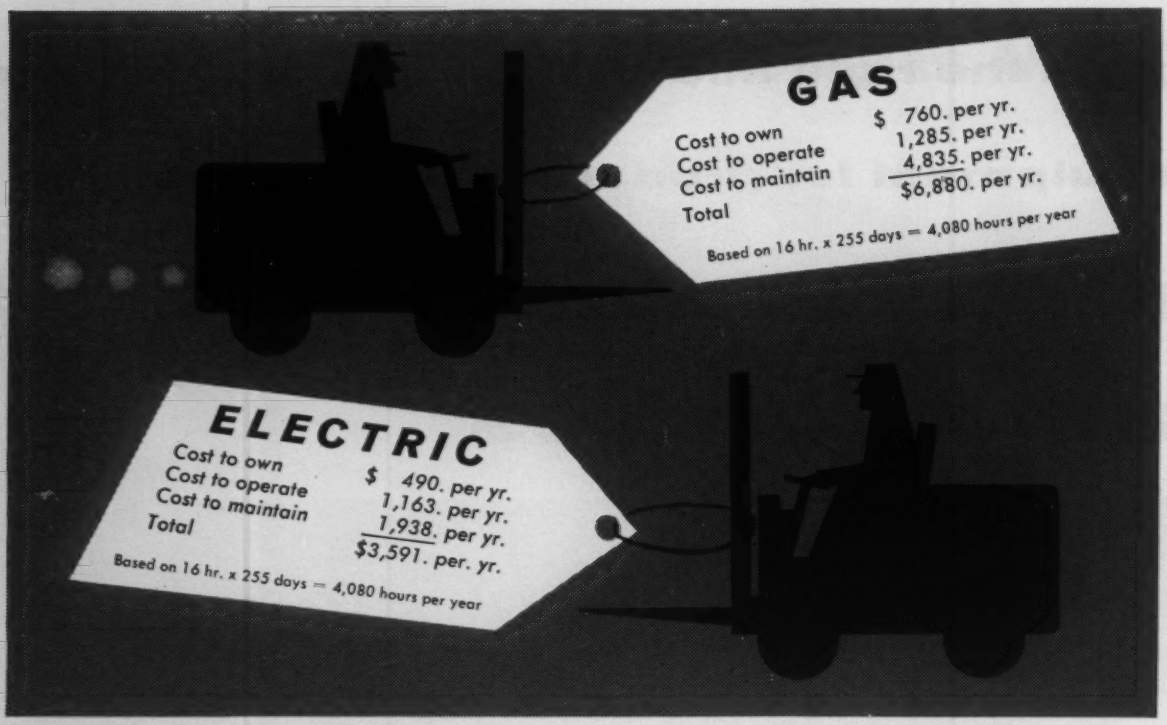
In equipment, the first endothermic atmosphere generator was developed by Lindberg many years ago. Through the years generators for varied types of metal treating atmospheres have been developed, including units for exothermic, dissociated ammonia and inert atmospheres. And we have kept adding refinements and improvements to set continually higher standards of efficient and economical performance.

Years ago, too, Lindberg designed the first equipment for controlling metallurgical atmospheres, the Lindberg Carbotrol. For this, Lindberg research also created dew point equilibrium curves to establish proper atmosphere values for types of steel and temperatures involved. The Carbotrol automatically controls these values. It is also available incorporating the new CO_2 infra-red system of control. Since Lindberg makes both types we are in an ideal position to recommend the method most suitable for your specific processes.

When you visit us at the Show you'll also be able to get the latest information on Lindberg's complete line of heat treating equipment, everything from a laboratory furnace no bigger than a breadbox to a gantry type installation six stories high.

If you don't get to see us at the Show you can get full information on all Lindberg equipment from your local Lindberg Field Engineer (see your classified phone book) or write us direct. Gas Process Division, Lindberg Engineering Company, 2441 West Hubbard Street, Chicago 12, Illinois.

Los Angeles plant: 11937 S. Regentview Avenue, Downey, California. In Canada: Birlefco-Lindberg Ltd., 15 Pelham Ave., Toronto 9, Ont. Also, Lindberg plants in Argentina, Australia, England, France, Italy, Japan, Spain, Switzerland and West Germany.


GAS
Cost to own $ 760. per yr.
Cost to operate 1,285. per yr.
Cost to maintain 4,835. per yr.
Total $6,880. per yr.
Based on 16 hr. x 255 days = 4,080 hours per year
ELECTRIC
Cost to own $ 490. per yr.
Cost to operate 1,163. per yr.
Cost to maintain 1,938. per yr.
Total $3,591. per. yr.
Based on 16 hr. x 255 days = 4,080 hours per year

What's The Real Price Tag?

An ELECTRIC TRUCK can save you over *$3,200 per year*

The real price tag to look at on an industrial truck is the *cost per year,* not the initial price.

When you consider that what you are actually buying is not the truck but the *total amount of work that the truck will deliver,* an electric has been proven to be the best buy.

Here are the reasons:

- Electric trucks have at least double the working life of gas powered trucks because their mechanism is much simpler. This lowers depreciation cost and means that ELECTRICS COST LESS TO OWN.
- During the past twenty years the price of gasoline has doubled while the cost of electric power has remained constant. As a result, ELECTRICS COST LESS TO OPERATE.
- Actual maintenance records in industry prove that ELECTRICS COST LESS TO MAINTAIN.

Send for free 12-page booklet which gives further information on this subject and includes calculator charts which make it easy to make cost comparisons on your specific industrial truck operation.

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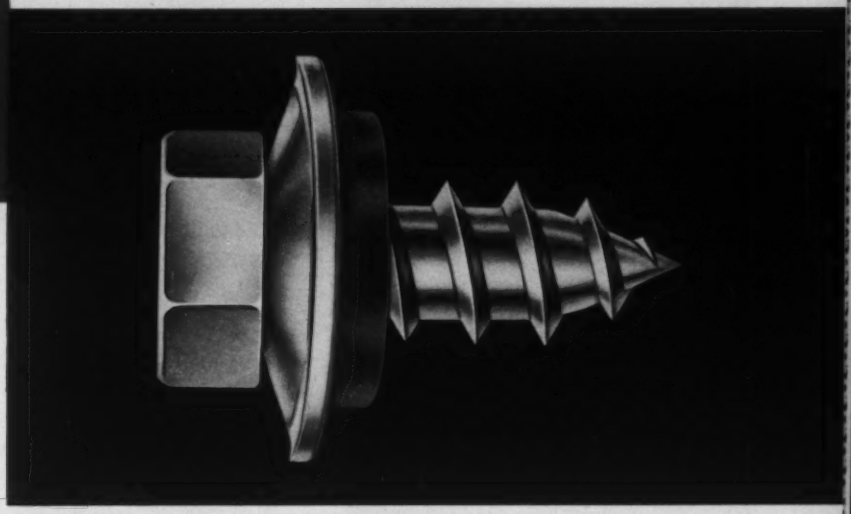

sealed for savings

In the steel building industry, leaking roofs mean leaking profits. GLS field engineers, studied this problem at the job site to determine the cause and perfect the cure. The result of this field development project is the positive sealing "Poz-i-seal" sheet metal screw. GLS engineers can plug *your* profit leaks by designing custom fasteners to meet your exact manufacturing needs. Standard products - though cheap to buy - are costly to use and even more costly to remove and replace when failure occurs. If you have a special fastening problem - let GLS seek the solution for you - and develop the cure. Custom made fasteners put the lid on high costs. They are *sealed for savings.*

GSL

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Reliable Rodney asks:

NEED *Stainless Steel* PRECISION GAUGE THIN STRIP OR FOIL?

SPECIALISTS IN CLOSE-TOLERANCE THINNESS

Rodney concentrates its entire efforts, research and production, toward furnishing super thin, extra wide, cold rolled precision gauge strip in all tempers and finishes. With the entire capacity of the plant and personnel devoted exclusively to this specific area, Rodney has acquired a wealth of "know-how", manufacturing experience, quality control, and application knowledge . . . ready for your use!

STAINLESS STEEL STRIP — All Alloys

Widths — ⅛" to 24" Gauges — .012" to .0003"
All Tempers and Finishes.

Rodney furnishes Stainless Steel Strip in all alloys, but specializes in Types 301, 302, 304, 305, 316, 321, 347, 17-7PH, PH15-7MO, 410 and 430, the most commonly used. Rodney's unique ability to produce strip in gauges as thin as .0003" and as wide as 24" makes, in effect, a new kind of material available to design engineers and fabricators. Rodney furnishes strip in all finishes to meet your requirements.

In many applications, Rodney's bright annealed stainless steel makes polishing unnecessary. For example, 300 Series Stainless Steel is available in dead soft temper with a mirror finish on both sides.

For high tensile strength applications material can be furnished approaching 300,000 PSI. Intermediate tempers are also available. Thickness tolerances, when required, can be held to within ±3% of gauge even across the widest strip.

SPECIAL ALLOYS

Exotic metals, high temperature and other special alloys for space age applications are regularly rolled to exacting specifications by Rodney. Rodney's laboratory is fully equipped with the latest instruments for mechanical and chemical testing, and Rodney's experienced research and development personnel are always available for consultation on your special problems.

ALUMINUM ALLOYS AND CARBON STEEL STRIP

Precision processed to exacting specifications on request.

SPECIALTY CUSTOM ROLLING

Rodney will work with you on special super thin rolling of all metals, pure or alloy, within the general range of .0003" to .005" thickness and in widths up to 12½".

- **PRECISION ROLLING**
- **RANGE OF MATERIALS**
- **QUALITY CONTROL**
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- **ACCURATE SLITTING**
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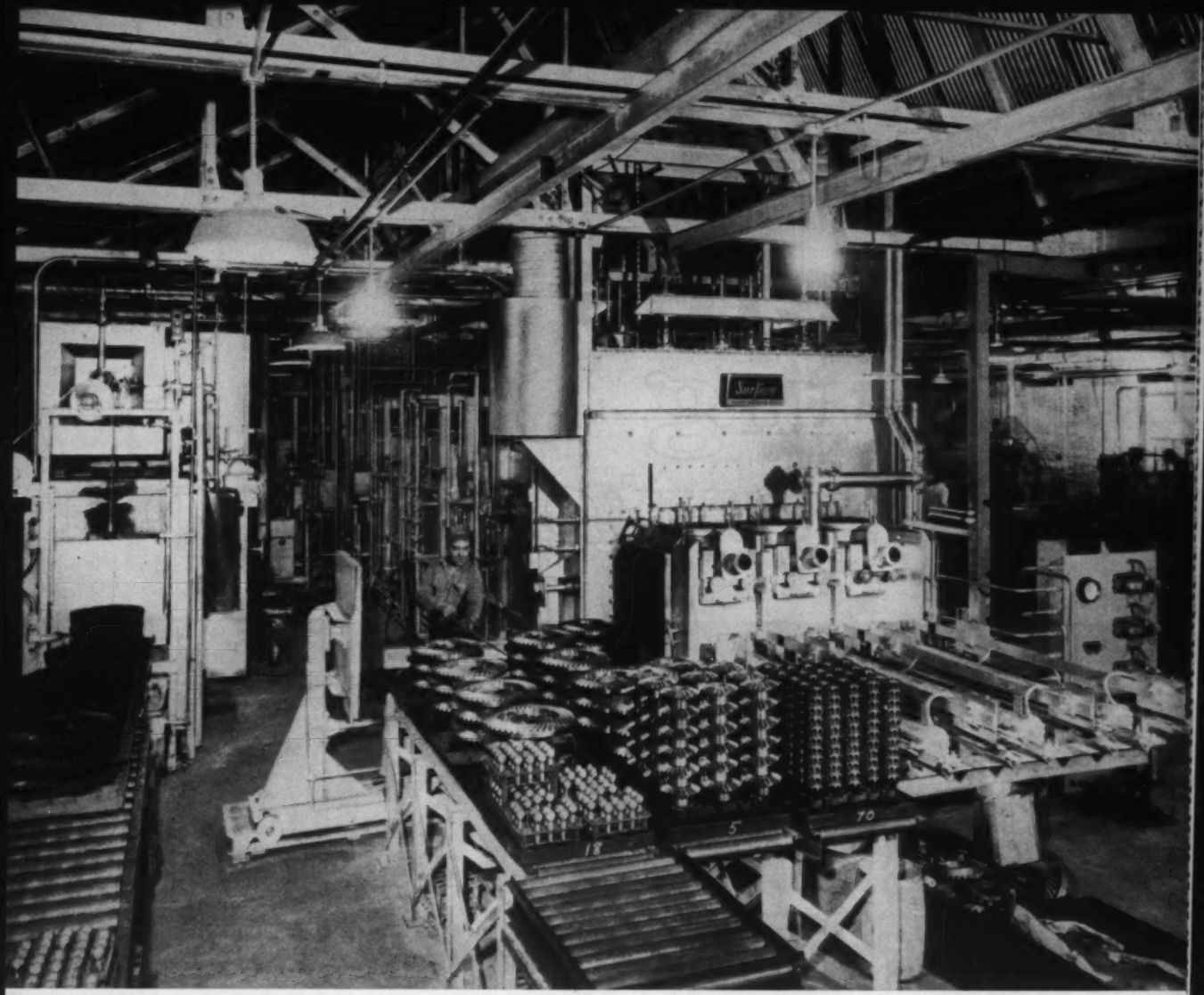
West Coast Office & Warehouse: 5462 East Jillson Street, Los Angeles 22, Calif.



Continuous carburizing furnace replaces pack processing at a profit.

Several pack carburizing furnaces have been replaced by one Surface continuous gas carburizing furnace which has paid off for the White Motor Company.

They have improved the quality and uniformity of finished parts as a result of superior process control. At the same time, they are cutting inspection costs and realizing more efficient floor space utilization. Costly supply inventories required by former processes have been eliminated.

Atmosphere carbon potential in two of the five furnace zones is monitored automatically by a Surface Autocarb® System. Parts requiring press quenching are removed through a special slot door at right angles to the regular discharge door. The 57′ furnace carburizes 700 pounds/hour of ring gears, spider gears, studs, pins, and heavy parts.

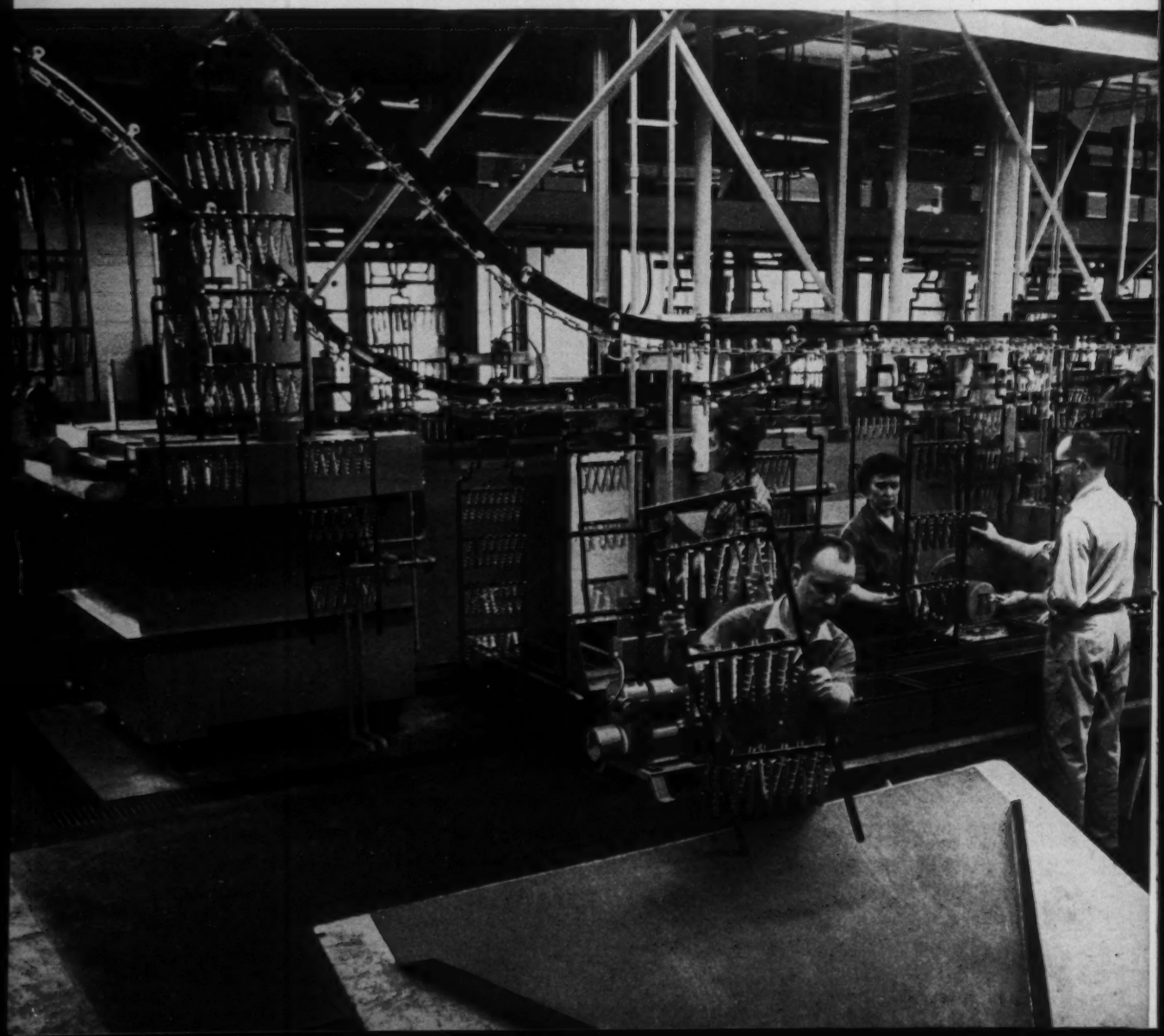
Write for information: 2385 Dorr St., Toledo 1, Ohio. In Canada: 2490 Bloor St., West, Toronto.

Check our latest developments at the Metal Show, Oct. 23-27, in Detroit's new Cobo Hall

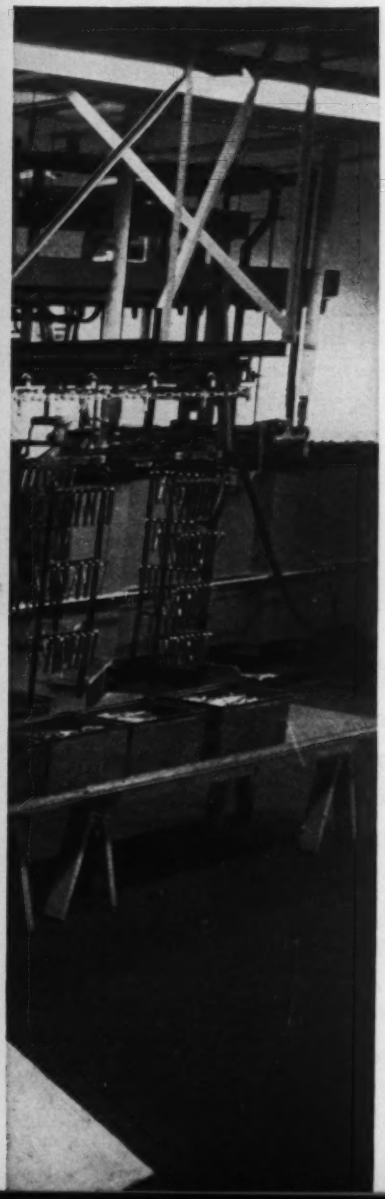
SURFACE

SURFACE COMBUSTION, Toledo 1, Ohio/ a division of Midland-Ross Corporation MR

here's plating automation



at its best!



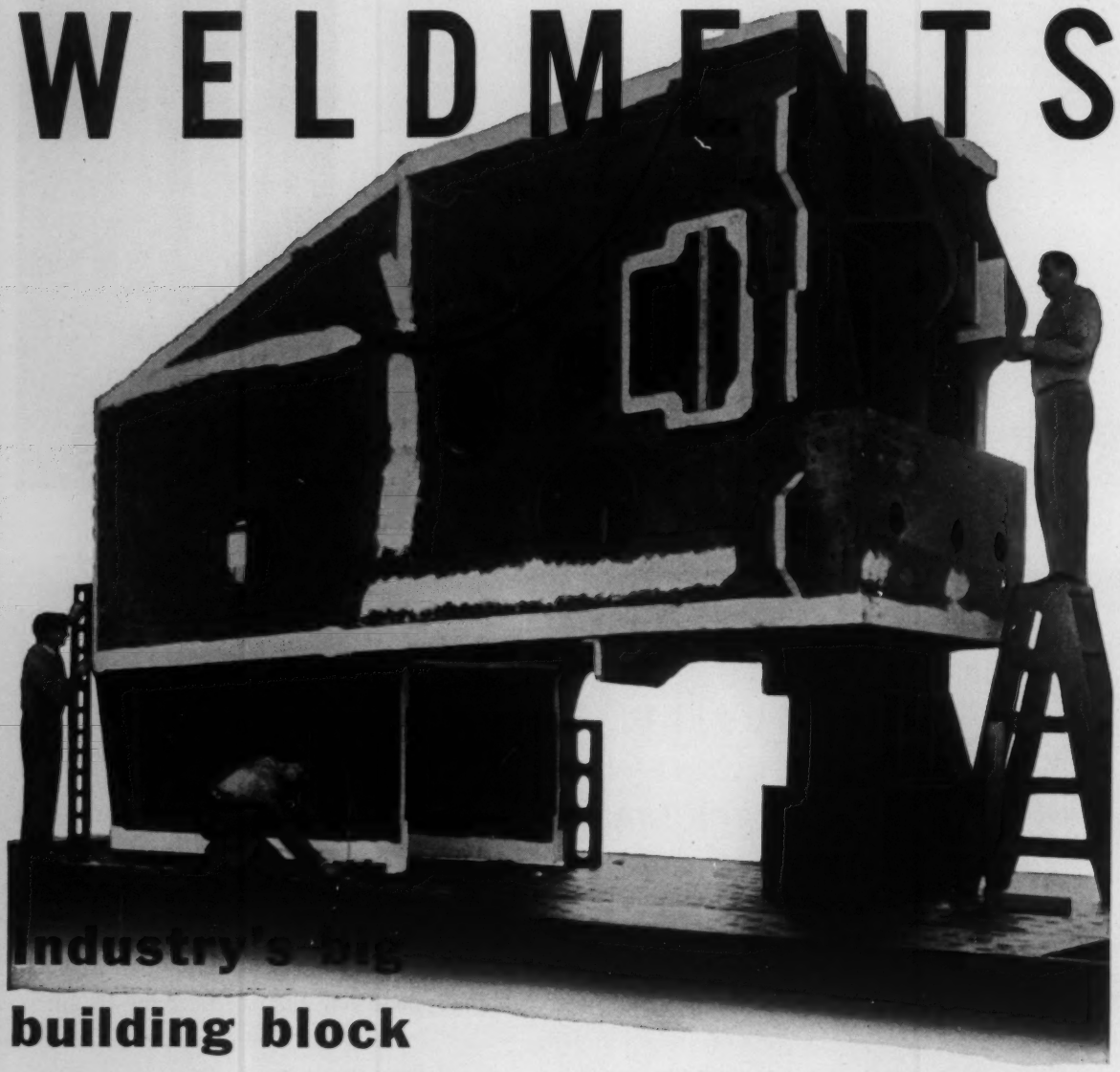
Udylite Cyclemaster ties into plant conveyor system, features automatic rack loading and unloading mechanism

A fully-automatic Udylite Cyclemaster was selected by Koelling Metal Parts, St. Louis, Missouri, to meet high-production, high-quality plating requirements on looseleaf binder and catalog components. This 15-station machine with automatic load and unload mechanism, shown above, is tied directly into a "stop and go" overhead plant conveyor system for maximum material flow efficiency. ■ This Udylite Cyclemaster provides peak production flexibility for Koelling. It operates at any rate from 40 to 120 racks per hour with plating thickness easily varied from .0001″ to .001″. Parts of any size can be plated within the limits of the 16″ x 8″ x 36″ racks. ■ The Cyclemaster maintains exacting quality control standards, boosts plating volume and offers an important reduction in floor space requirements. To find out how you can obtain the ultimate in automatic plating today at a surprisingly low cost, call your Udylite Representative and have him tell you the complete Cyclemaster story. Then, let Udylite Engineers recommend the specific machine and conveyor system to best meet your requirements.

Udylite

THE UDYLITE CORPORATION
DETROIT 11, MICHIGAN

WELDMENTS



industry's big building block

You're looking at a 55-ton weldment on a planer. It is typical of the machining—or building of a complete machine of any size—produced regularly in the Sun Ship machinery plant where marine and industrial equipment is built.

In our tank and steel fabricating shop, we build pressure vessels, fractionating towers, weldments, and heavy steel fabrications.

Our completely integrated shops concentrate facilities and skills for producing special machinery and components that meet the most critical standards.

When you need special machinery of any kind, you will want to discuss methods, equipment requirements and possible production layouts with Sun Ship's sales engineers.

Sun

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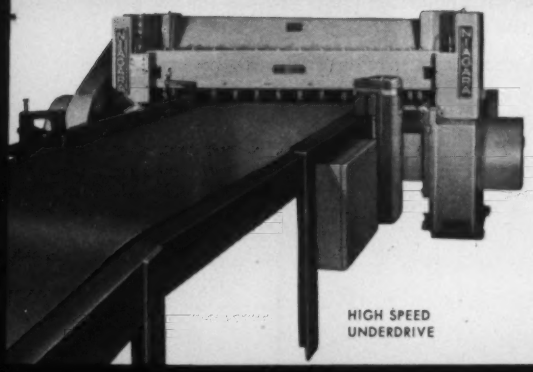
UNDERDRIVE

GAP TYPE



HIGH SPEED
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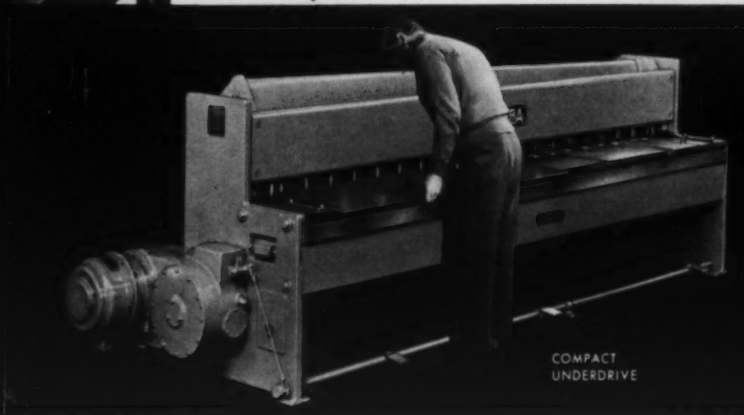
choose the exact shear from the largest line anywhere!



COMPACT
UNDERDRIVE

FOOT and
AIR OPERATED

Why compromise on a "nearly right" machine? Choose *Niagara* and you'll choose exactly what you need — for 1" plate or paper-thin sheet metal . . . short pieces or 20' lengths . . . automated high speed production or single stroke operation. Niagara has the world's largest selection of squaring and other types of shears . . . *nearly 150 models.*

Rugged underdrive and gap type giants for heavy industry and steel warehouses. "Middleweights" for medium gage material. Economy power and foot shears for the sheet metal shop. Slitting and ring and circle shears. Yes, even hand snips! There's no line like the Niagara line . . . *anywhere!*

Next time you need shears *of any kind,* take advantage of the greatest range and variety in the business. Select Niagara.

Keep the full Niagara shear story on file. Send for any or all of these bulletins:

Underdrive Power Squaring Shears (to 1" plate)	Bulletin 69
Power Squaring Shears with Gap (to 5/8" plate)	Bulletin 72
Power Squaring Shears (Medium Gage)	Bulletin 73
Power Squaring Shears (Light Gage)	Bulletin 71
Air Power Squaring Shears	Bulletin 87
Foot Squaring Shears	Bulletin 80

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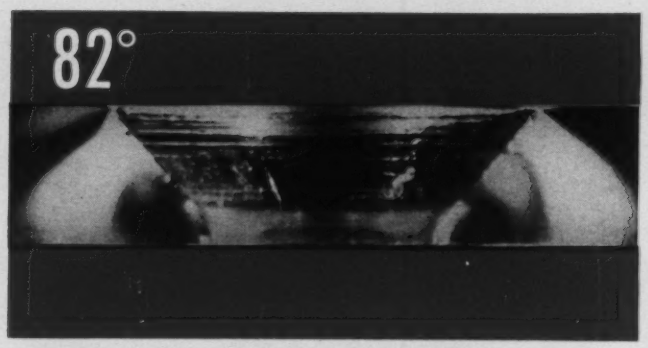
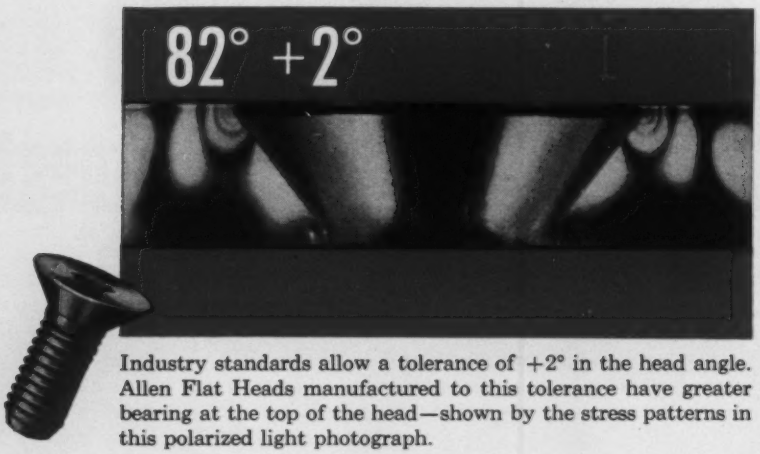
America's most complete line of presses, press brakes, shears, other machines and tools for plate and sheet metal work.

PQA* proves it...

this Allen Flat Head Cap Screw has complete all-around head contact

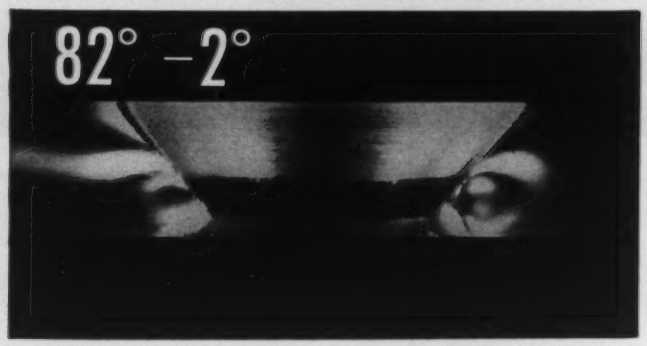


PQA makes it certain that an Allen Flat Head Cap Screw has contact throughout the angle of the head with the mating countersunk hole. This assures the strongest possible fastening. In this photo, made with polarized light, you can see the stress points throughout the chamfer.



Industry standards allow a tolerance of +2° in the head angle. Allen Flat Heads manufactured to this tolerance have greater bearing at the top of the head—shown by the stress patterns in this polarized light photograph.

*PRODUCT QUALITY ASSURANCE



Industry also allows a tolerance of −2° in the head angle. *But Allen does not utilize this negative tolerance.* The reason—it is entirely possible to have head seating efficiency reduced because of excessive interference in the head-shank area. The photo shows high bearing stress in this area—with risk of breaking prematurely.

PRODUCT QUALITY ASSURANCE is the symbol of unquestioned quality at ALLEN. It stands for *constant* quality control every step of the way—your guarantee of quality and reliability.

ALLEN

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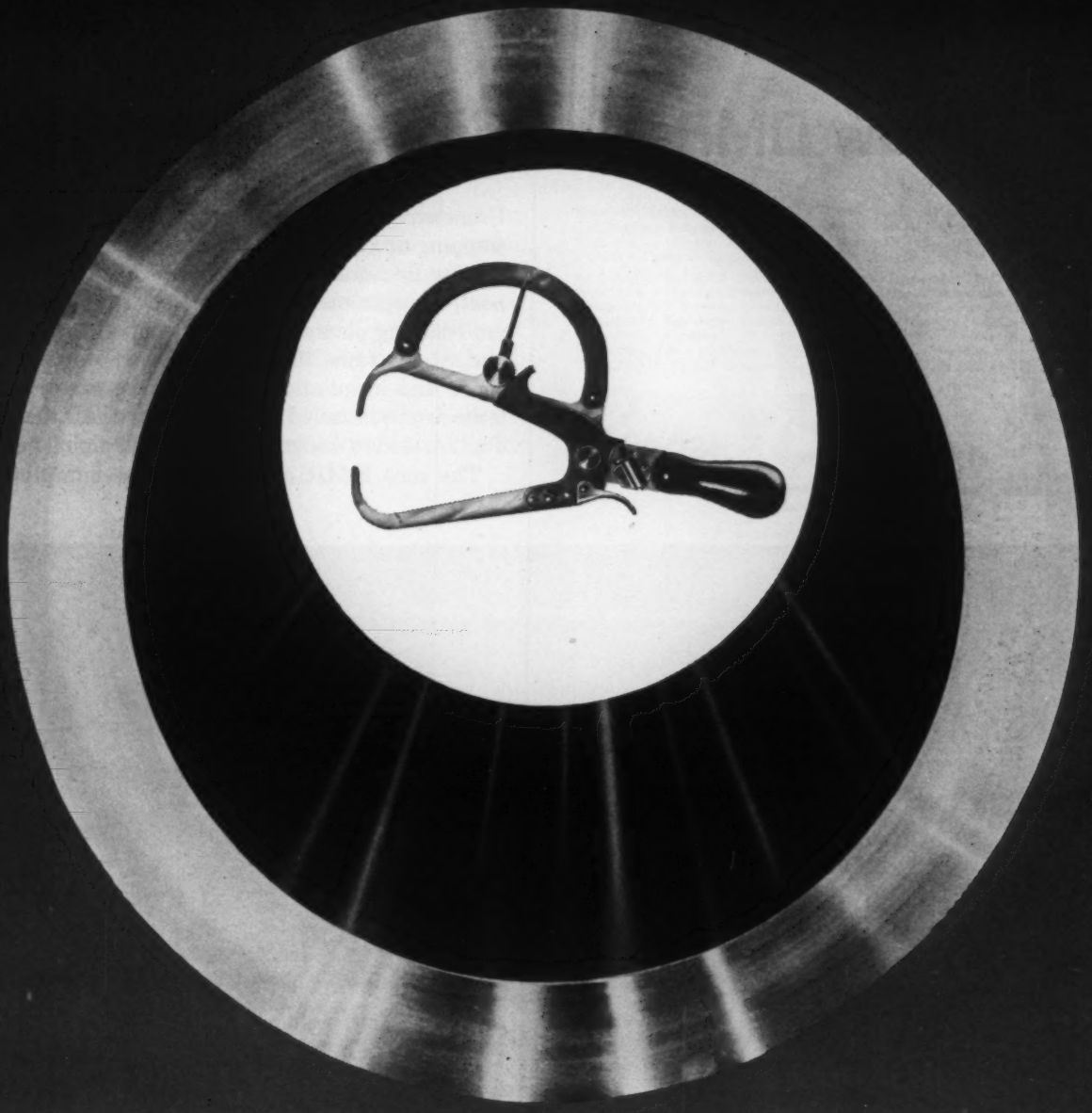
Genuine ALLEN products are available only through your ALLEN Distributor. He maintains complete stocks close by to help cut your freight costs, inventory, warehousing and handling. He offers fast, single-source service. He knows ALLEN products. And he makes ALLEN Engineering Service available to you any time. Call him!

ALLEN HEX-SOCKET SCREWS HEAD



NEW SIZE RANGE SURPRISE!

HERE'S A NEW PROCESS in centrifugally spun tubing that offers you greater freedom in design. It's ACIPCO CERAM-SPUN®... the new ceramic mold process* that is not limited by equipment sizes!

NOW, YOU CAN ORDER almost any combination of sizes you require. ACIPCO CERAM-SPUN® tubes offer O.D.'s from 2.25" to 50"; and wall thicknesses from .25" to 8". As-cast lengths are furnished from 4 feet to 20 feet, longer lengths are made by welding.

THINK OF HOW MUCH this process can save you! You'll avoid the cost of unnecessary metal waste, and excessive machining charges. And ACIPCO's complete "under one roof" operations — including heat treating, machining and welding — offer many additional economies. No need for the delays and excessive costs that often result in buying from multiple sources.

If you design, manufacture or use tubular component parts, it will certainly pay you to investigate the versatility of ACIPCO CERAM-SPUN® tubing and the flexibility of ACIPCO's integrated facilities. Contact **ACIPCO STEEL PRODUCTS,** Division of American Cast Iron Pipe Company, Birmingham 2, Alabama.

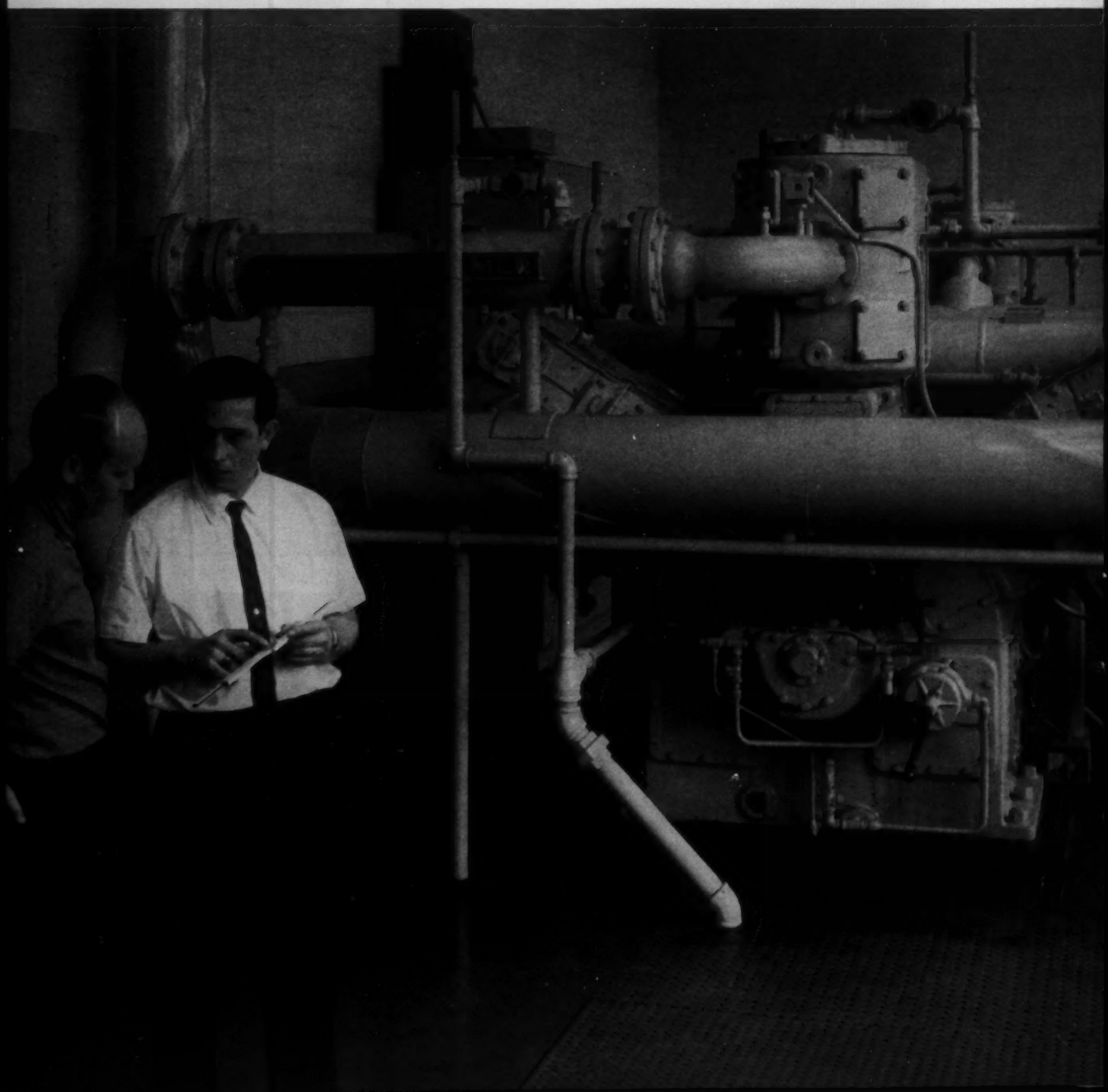
*Patent applied for

ACIPCO CERAM-SPUN®
STEEL TUBING

How DMR Air Compressors boost

Users everywhere report important economies by stepping up compressed air capacity with the new Cooper-Bessemer DMR compressors. These *compact*, 720 rpm machines, unmatched in reliability, are enabling plants to boost output with air tools and, at the same time, conserve compressor floor space and installation cost. In most cases, these units can be installed in existing space near the production load to minimize housing and piping needs.

The new DMR compressors are completely



your production...cut floor space needs

equipped with integral motor drive and intercooler ... ready for operation. Their En-Tronic control, also integrally mounted, automatically regulates the compressors to meet the demands of the air system. They are available in 2 or 3 cylinder designs, 150 to 400 hp, 698 to 2005 cfm at discharge pressures up to 125 psi.

For full particulars, call the nearby Cooper-Bessemer office or air compressor agent. Write for Bulletin 94 on the new DMR line.

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JET-POWERED GAS TURBINES

IN A FOUNDRY

... This Cooper-Bessemer DMR-3 air compressor delivers 1658 cfm for portable tools in a Pennsylvania foundry.

IN A FABRICATING PLANT

... This Cooper-Bessemer DMR-2 compressor supplies 757 cfm air at 125 psig pressure for portable tools.

COMPLETE INFORMATION

on the new line of compact DMR compressors is given in this booklet... free on request. Ask for Bulletin 94.

Advertisement by American Hot Dip Galvanizers Association

$10,000. in Awards for Hot Dip Galvanizing Ideas

Ten awards offered by American Hot Dip Galvanizers Association in cooperation with American Zinc Institute

Galvanizers International Award

THINK! Think about new uses for Hot Dip Galvanizing! Or, improvements in present uses! Or, new methods of after treatment! If your idea is accepted, you will receive one of ten awards of $1000 in cash, plus a handsome medal, plus an engrossed Certificate of Achievement.

Not a contest but a search for new ideas

This is not a contest—it is a search for new ideas. Your entry will not be judged against others, but solely on its merit and value in developing new applications and markets for Hot Dip Galvanizing. If your idea, in the opinion of the judges, is of practical value to the industry, you will be cited for an award—promptly.

The Hot Dip Galvanizing Industry is anxious to receive ideas of this type; therefore, the judges reserve the right to present *more than 10 awards*, if the entries warrant.

These well-known men will act as judges

Dr. Clarence H. Lorig, Technical Director, Battelle Memorial Institute and Past President American Society for Metals. Mr. John R. Daesen, Technical Director, American Hot Dip Galvanizers Association. Mr. John L. Kimberley, Executive Vice President, American Zinc Institute.

Anyone is eligible to enter

Anyone in the world (except members of the American Hot Dip Galvanizers Association and the American Zinc Institute, and their employees and advertising agencies) may submit one or more entries.

Business firms or corporations may submit entries under their business name, instead of as individuals, if they choose.

Entries will be considered by the judges promptly upon their receipt. No entry received after April 30, 1962 will be considered.

These are the kind of ideas we're looking for:

The Awards will be made for ideas pertaining to: (a) Applications of Hot Dip Galvanizing to a new or unusual field, or; (b) An improvement in application in fields where Hot Dip Galvanizing is now being used, or; (c) New methods of aftertreatment of Hot Dip Galvanized products.

Each entry must contain:

(a) Description and documentation of application.

(b) Case history of the application or process accompanied by photo, drawings, formulae, etc.

(c) All technical data needed for the utilization of the idea submitted.

(d) Release of the application or idea for general use without payment or royalty other than the $1000 award.

Other conditions:

The decision of the judges will be final.

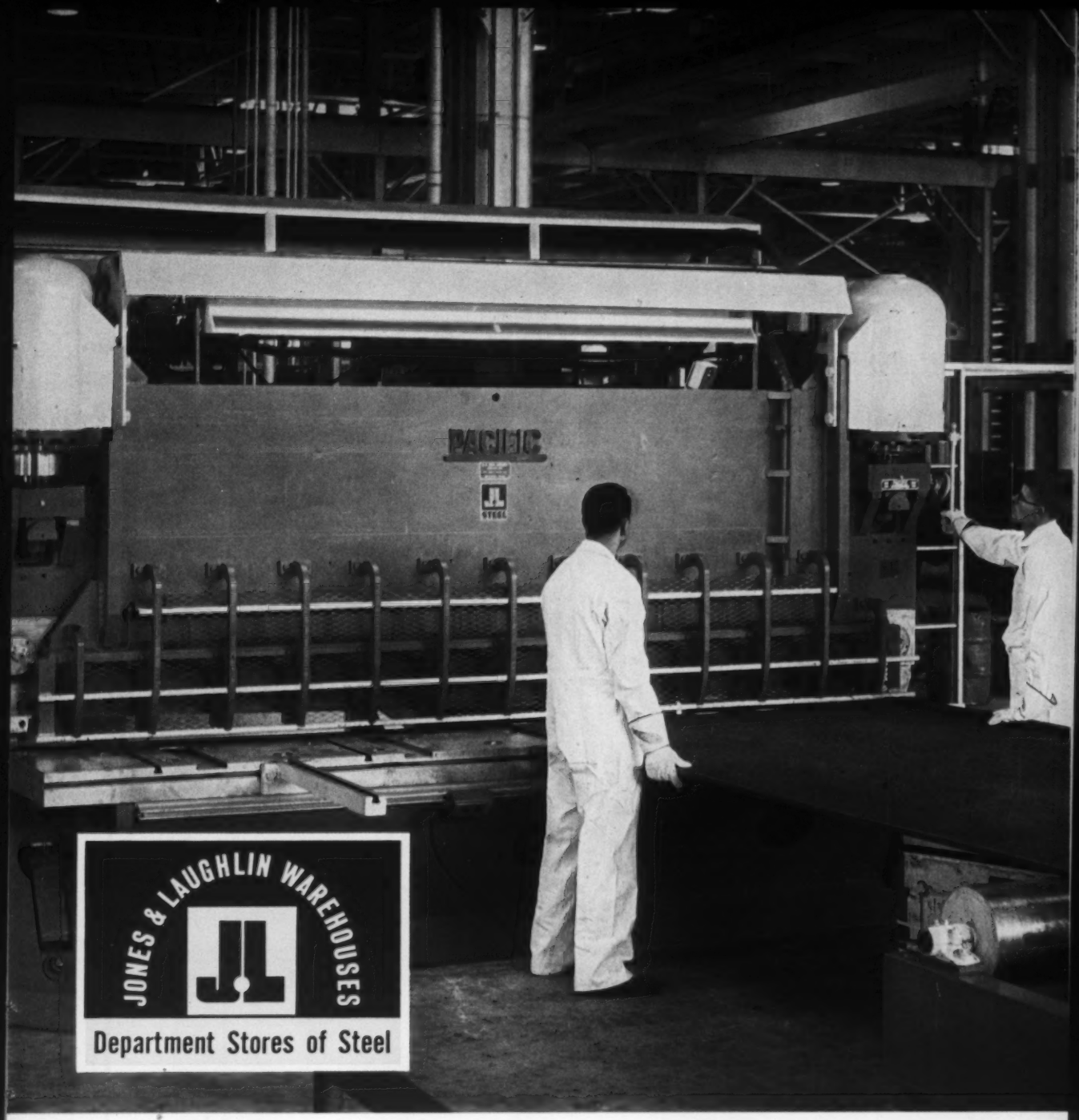
Award-winning ideas will be retained by the American Hot Dip Galvanizers Association for dissemination throughout industry. Other entries will be returned.

No formal entry blank is required. The entry should be accompanied by your name, address and business connection.

Entries should be sent to:

AMERICAN HOT DIP GALVANIZERS ASSOCIATION, INC.
5225 Manning Place, N. W.,
Washington 16, D. C.

Note: For information on galvanizing, write to the above address for name and location of the American Hot Dip Galvanizers Association member nearest you.



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HOW MICRO SWITCH FINISH GRINDS SMALL PARTS TO .0001"

Van Norman Centerless Grinders meet rigid design limits of famous precision snap-switches at high output-rate

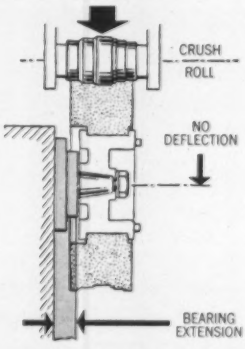
Close tolerances in vital parts are indispensable to MICRO SWITCH, suppliers of over 12,000 types of precision switches to home, industry, defense. This division of Minneapolis-Honeywell Regulator Co. gets accuracy and economy with VN Grinders.

.0001" on Thru-Feed—.0002" on infeed are met by VN units in volume-grinding actuator shafts and plungers for snap-action switches. Specs for multi-diameter concentricity and micro-inch finish are continuously held at high outputs (1,000 to 2,000 parts per hour on thru-feed; 120 to 250 on infeed).

Fast, Smooth, Vibrationless Operation is designed into VN Centerless Grinders. Massive Construction—well-coordinated components—lifetime-sealed spindle units. Result: strict control over work deflection . . . no warm-up, no chatter, no "creep." VN hyd. profile diamond dressing on both wheels, with cams for straight or multi-diameter parts.

Variable Speeds, Easy Set-Up, Operation Control. Two regulating wheel speed ranges: 13–80 and 140–830 RPM. Capacity 0–1½" dia. Optional: VN Crush Dressing Attachment.

Free Booklet.—"Centerless Grinding"—valuable guide to high production, lower costs. For your copy, contact factory or your local distributor.



Rugged, heavy Grinding Wheel Spindle with its additional bearing extension withstands the terrific pressures of crush roll forming with NO DEFLECTION.

2609

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VN

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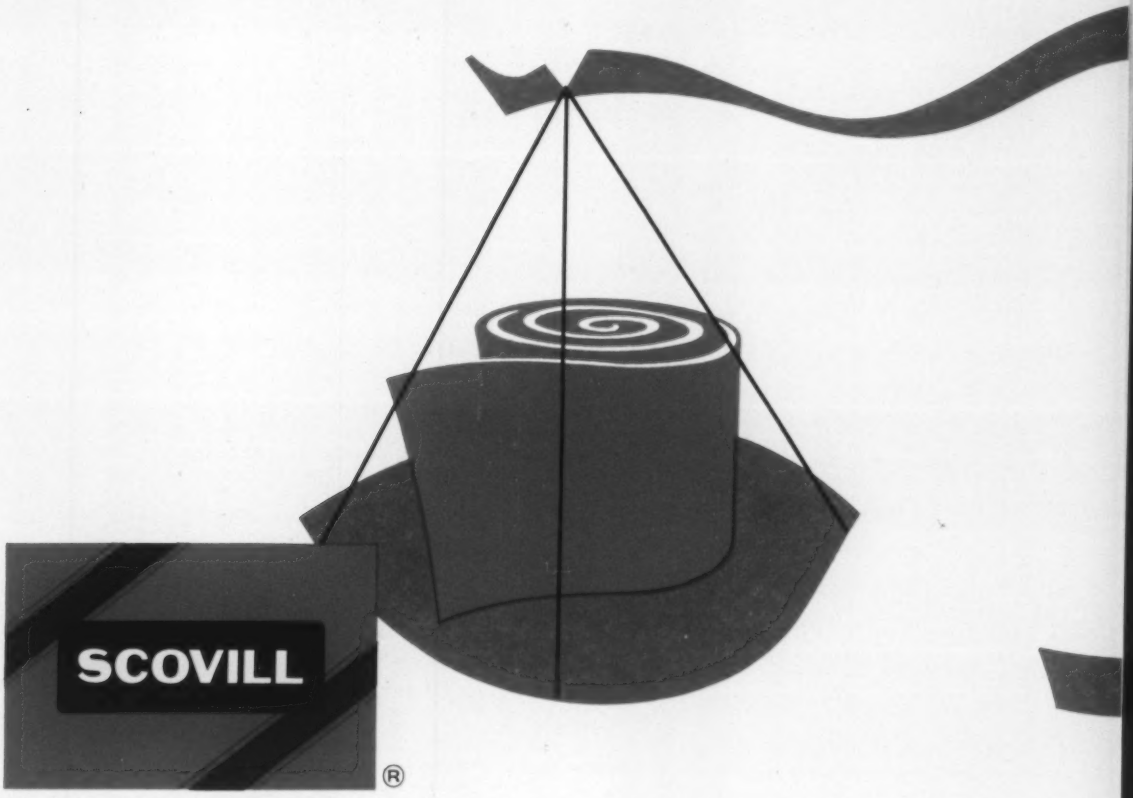
There *are* practical ways to solve cost problems without endangering a hard-won reputation. Scovill Technical men have helped many fabricators find them . . . have been able to suggest better alloy specifications for a given job, better packaging or delivery scheduling to help customers save time and money. Often the superior uniformity of Scovill Mill Products, and their better fabricating characteristics, help to lengthen tool life, reduce downtime, reduce rejects, and produce a finer finished product. It will be worth your while to talk to us.



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15SC61

Why you'll like being called a liar

Nobody will believe the results you get with the remarkable Hevi-Duty Tagliaferri furnaces ... but you can laugh all the way to the bank!

Lower costs, improved end products, and easy maintenance make Hevi-Duty Tagliaferri melters and receivers well worth your immediate inspection. Now operating in more than 1100 installations throughout the world, these 60-cycle induction systems are making important contributions to the art of making money.

HERE'S WHY YOU'LL LIKE THE MELTERS

Scrap and foundry returns melted with less than 1% loss

You can produce metals of high quality and controlled analysis from materials of the lowest grade. For both ferrous and nonferrous applications, these systems are available in capacities up to 30 tons.

No products of combustion or impurities added during melt

No products of combustion, sulphur or other impurities are added during melting or pouring. The furnaces are completely covered at all times and metal is poured from beneath the surface.

Controlled stirring for even blending — added strength

The electrical induction currents used to heat the charge also give a *controlled* stirring action which completely homogenizes the melt. Controlled stirring also reduces porosity and produces fine-grained iron of high strength and good machinability.

For nonferrous melting this controlled stirring results in a quiet bath with no turbulence at the metal surface. Oxidation and gas absorption are reduced. For brass melting, zinc losses are held to a minimum.

Low power consumption for low operating costs

The Hevi-Duty Tagliaferri induction furnaces use electrical power efficiently. These furnaces have a higher uncorrected power factor than competitive induction units. Thermal efficiency is about 78%.

Furnaces can start from cold — shells are interchangeable

Melting furnaces start from cold. No hot metal is needed. When it is necessary to change alloy or to interrupt operation, furnaces can be emptied completely.

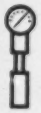
Maintenance and cleaning are simplified

The channels in the non-ferrous furnaces are *easy* to inspect or clean; simply tilt the furnace forward and open the channel doors. A heel of molten metal can be left in the furnace during cleaning

Relined furnace shells can be installed without disconnecting electrical or hydraulic equipment.

HERE'S WHY YOU'LL LIKE THE RECEIVERS

Increased tensile strength after 20 minutes



Hevi-Duty Tagliaferri electric induction receivers take metal from the cupola and, in 20 to 30 minutes, homogenize it to produce iron of higher tensile strength.

Improved machinability

Metal refined in these receivers is fine-grained with a uniform structure resulting in good machinability.

Fluidity of metal increased by receivers — lower pouring temperature possible

Mold details fill more completely. Thinner sections can be cast successfully. And, products can often be redesigned to use less metal.

No loss of alloy

Alloying is accomplished in Hevi-Duty Tagliaferri receivers without loss of alloys. Raw iron from the cupola can be held in the receiver and analysis carefully controlled. Holding is possible for as long as 48 hours without analysis change.

Temperature controlled closely

Temperature can be adjusted within the receivers to best suit pouring conditions. Proper metallurgical analysis can be achieved. Steel scrap can be added to adjust the chemistry.

Get the full details

For information on Hevi-Duty Tagliaferri systems contact your nearest Hevi-Duty sales engineer or write Hevi-Duty Electric Company, Watertown, Wisconsin. Request Ferrous Bulletin 6051 — or Nonferrous Bulletin 6052.

HEVI-DUTY

B P
C

Electric and Fuel-Fired
Industrial Furnaces and Ovens

HEVI-DUTY ELECTRIC COMPANY
WATERTOWN, WIS.
A Division of Basic Products Corporation

SEE THESE FURNACES IN BOOTH 151 AT THE METAL SHOW

Hyde Park
Gray Iron and Alloy Iron Castings up to 80,000 Pounds!

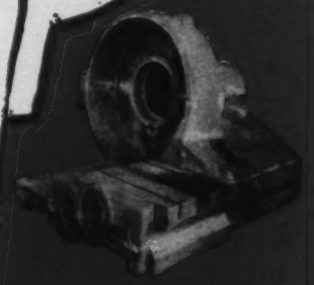
ROLLS
Alloy Iron Rolls
Grain Rolls
Chilled Rolls
Nickel Chilled Rolls
Body Rolls
Cold Rolls

ROLLING MILL EQUIPMENT
Bar Mills
Merchant Mills
Sheet and Strip Mills
Pinion Stands
Roller Tables
Reduction Drives
Straighteners
Levelers
Guillotine Shears
Sheet Mill Shears
Roll Lathes
Special Machinery
Machine Work

Our foundry and machine shop facilities are equal to any of your requirements.

Castings up to 80,000 pounds—
Furnace Castings • Machinery Castings
Heavy Die Castings • Slag Pots
Bases • Heavy Tool Castings • Housings
Floor Plates

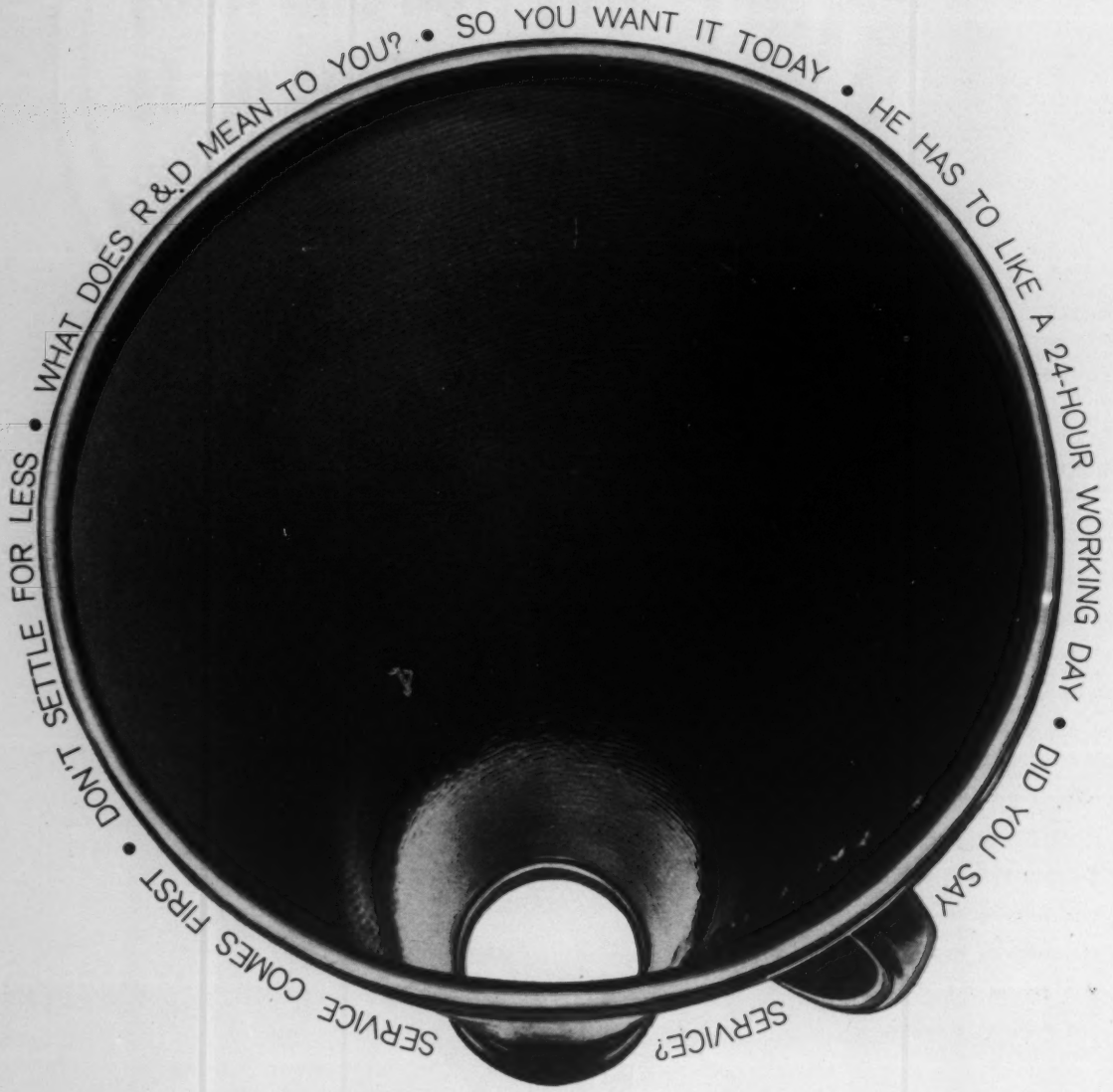
NOW, with expanded Heavy Machine Shop facilities, Hyde Park welcomes the opportunity to work with you on any of your equipment problems.



RED CIRCLE Rolls ALLOY-CHILLED

Hyde Park FOUNDRY & MACHINE CO.
HYDE PARK, WESTMORELAND COUNTY, PITTSBURGH DISTRICT, PA.

we've said our piece about VCA service


SO YOU WANT IT TODAY • HE HAS TO LIKE A 24-HOUR WORKING DAY • DID YOU SAY SERVICE? • SERVICE COMES FIRST • DON'T SETTLE FOR LESS • WHAT DOES R&D MEAN TO YOU? •

VCA "SERVICE COMES FIRST" CONTEST

You've seen the ads. You've read the story of VCA's "extra-value-through-extra-service" policy. You're aware of the importance to the industry and to your company of VCA's fully integrated operation, R&D program, complete product line, strategically located plants, and all the other things we've discussed. But there's one thing the ads couldn't cover... how VCA Service has helped you specifically. So, we're running a contest... a contest to get you to tell us.

Who Can Enter. The VCA "SERVICE COMES FIRST" CONTEST is open to anyone who has benefited from VCA service... researchers, PA's, production men, engineers, melters, even presidents.

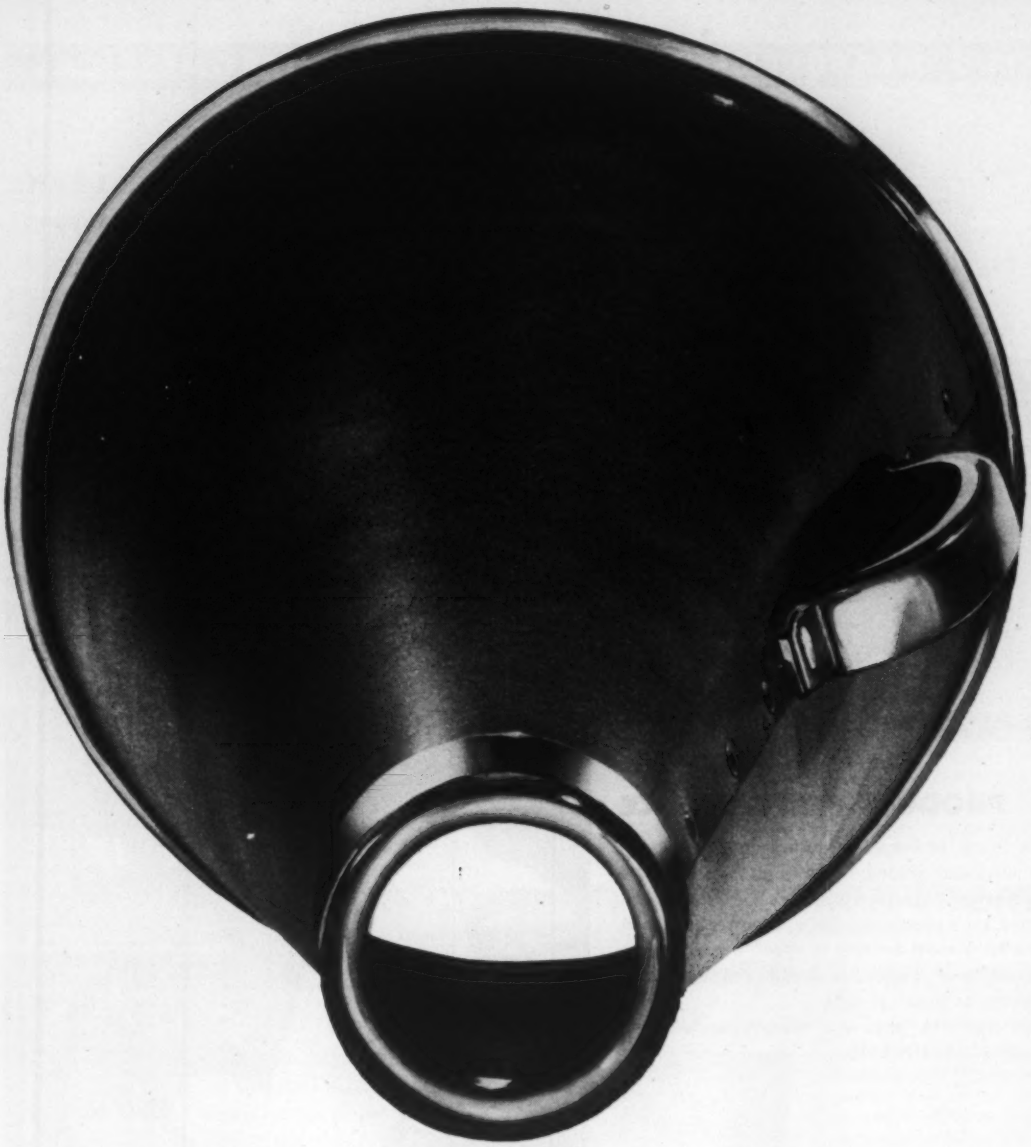
How To Enter. Simply write a letter describing how VCA SERVICE has at some time or other helped you or your company solve a problem, cut costs, do a better job or make a better product. Tell us how, why, when, where, and for whom. Letters may be handwritten or typed, and may be of any reasonable length. Sketches, photographs or other supporting evidence may be included.

Judges. The VCA "SERVICE COMES FIRST" CONTEST will be judged by a distinguished panel chosen from editorial, university, association and industry sources. Names will be announced at a later date.

Closing Date. Entries must be mailed to

VCA "SERVICE COMES FIRST" CONTEST
Vanadium Corporation of America
420 Lexington Ave., New York 17, N. Y.

and postmarked no later than November 20, 1961. Entries become the property of VCA and cannot be returned.



now you tell us

Prizes.

1st. .....FIVE — $100 U. S. Gov. Bonds, Series E
2nd. .....FIVE — $50 U. S. Gov. Bonds, Series E
3rd. .....FIVE — $25 U. S. Gov. Bonds, Series E

Additional Prizes.

4th .....$100 U. S. Gov. Bond, Series E
5th ..... $50 U. S. Gov. Bond, Series E
6th ..... $25 U. S. Gov. Bond, Series E
7th ..... $25 U. S. Gov. Bond, Series E
8th ..... $25 U. S. Gov. Bond, Series E
9th ..... $25 U. S. Gov. Bond, Series E
10th ..... $25 U. S. Gov. Bond, Series E

Bonus Prizes.

100 Stainless Pens for first 100 letters received. In the case of a tie, judges will award duplicate prizes.

Winners will be announced on December 20, 1961. Bonds will be registered in the winners' names and forwarded immediately.

Get More Information at the METALS SHOW. "SERVICE COMES FIRST" will be the theme of VCA's booth at the Metals Show. For more information about the contest, visit VCA Booth No. 338 at the show, being held this year in Detroit, Mich., October 23-27. **DON'T DELAY.. ENTER TODAY**

VANADIUM
CORPORATION OF AMERICA
420 Lexington Avenue, New York 17, N. Y.
Chicago • Cleveland • Detroit • Pittsburgh

BREAKING MEASUREMENT BARRIERS WITH MICROMETRICAL

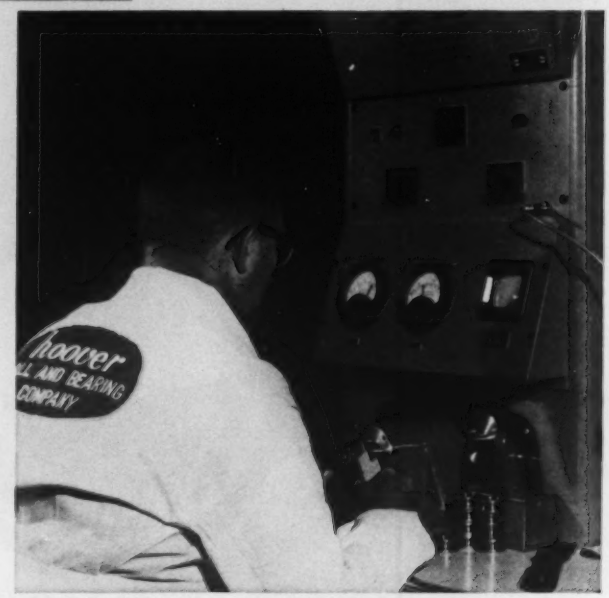
COUNTS ROUGHNESS PEAKS FOR CLOSER SURFACE CONTROL

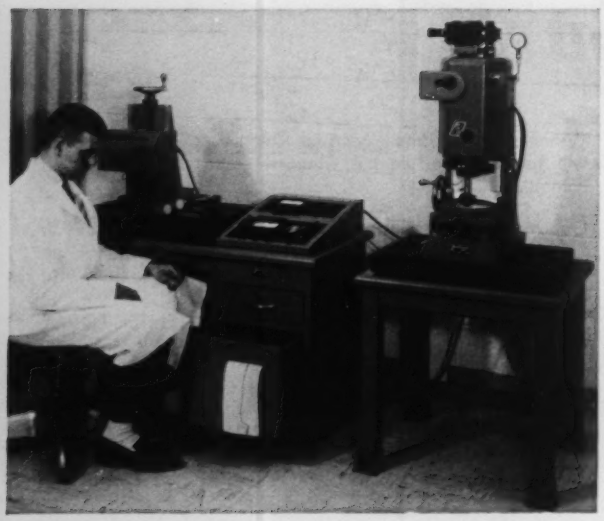
The Profilometer® with Peak Counter adds a new dimension to control of surface finish. This new combination shows the number of roughness peaks above a preselected height, in addition to showing average roughness height in microinches. We developed it to help solve surface-finish problems for sheet steel makers and users; and it has many other potential uses—perhaps in YOUR plant. Ask for BULLETIN LT143 and see.

MEASURES SURFACE WAVES TO AID PRODUCT PERFORMANCE

With many products, performance depends on the waviness around surfaces of rotation. The Wavometer® measures such waviness, in microinches, on a production basis. Example: In meeting a Navy quiet bearing contract, a ball bearing manufacturer checks the waviness around every raceway, as shown at right.

For waviness facts and Wavometer features, ask for BULLETIN LT10.





SHOWS FULL DETAILS OF ALL SURFACE IRREGULARITIES

In research or inspection, would it help you to know the height and length of surface waves, bows, or roughness irregularities? Dimensions and location of flaws or wear? Straightness, roundness or concentricity of ID's and OD's? Alert manufacturers in many industries meet ALL such needs with the Proficorder®—get pen-drawn magnified profiles that show exactly what they need to know. Interested? BULLETIN LT24 tells all about it.

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Manufacturer of the PROFILOMETER® • PROFICORDER® • MICROCORDER®
WAVOMETER® • ANDEROMETER® • VAROMETER®

Ingot Mold Cars . . .

built to last by a company that uses them!

5 unique structural features make them better

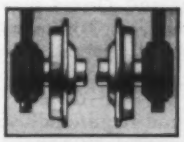
Ingot Mold Cars take more punishment than perhaps any other cars in a modern steel plant. In the 40 years we have been making these cars for our own use, United States Steel has developed a number of features in structural design that assure longer life, less maintenance and dependable service.

Shown here is a typical 8-wheel, 200-ton capacity Ingot Mold Car. The advantages illustrated at the right—plus the rugged durability of all-welded rolled-steel construction—make any size USS Ingot Mold Car a profitable investment.

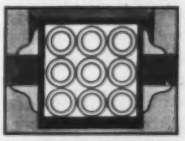
Our representative will be pleased to call at your convenience to discuss your requirements for this or any other type of industrial car. For more information, write to United States Steel, 525 William Penn Place, Pittsburg 30, Pennsylvania. USS is a registered trademark.

United States Steel Corporation • Columbia-Geneva Steel Division • Tennessee Coal and Iron Division • United States Steel Export Company

USS United States Steel

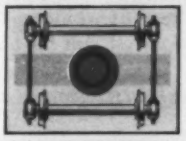


Anti-friction outboard bearings: High-capacity anti-friction bearings are located *outside* each of the car's eight wheels to minimize sidesway and to provide long, smooth-running performance.



Seventy-two coil springs: Nine coil springs between each two wheels on both sides of the car—plus nine overload coils *inside* these—provide a total of 72 separate springs for a shock-absorbed *level* ride, so important in hauling molten metal.

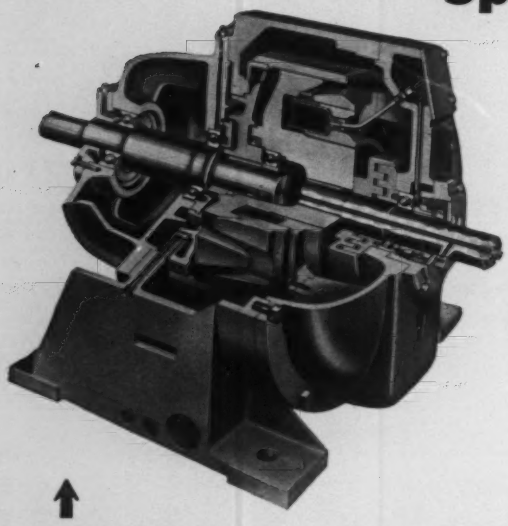
High engineering safety factor: Designed for a 200-ton normal capacity load—including ingots, molds and stools—each car has a substantial built-in safety factor to withstand maximum ingot-stripping thrusts.



Oversize center plates: "Beefed-up" center plates between the trucks and car body are 18 inches in diameter—compared with the conventional 12 inches—to reduce the load per square inch on their surfaces.

Hot-metal shields: Curved end plates, long side skirts, and special drip shields protect the couplers, bearings and springs from runover molten metal and troublesome solidified drippings.

The BEST Solution to Difficult Speed Control Problems—

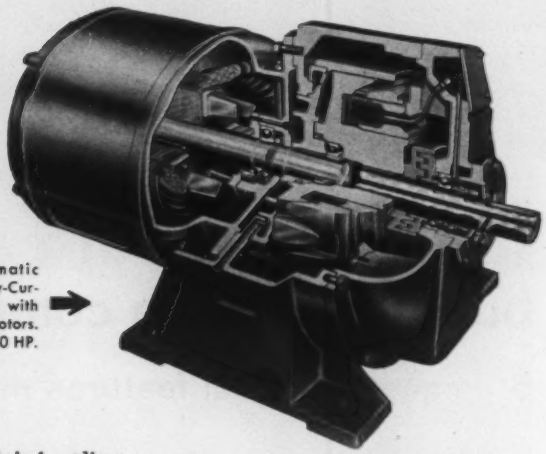


Dynamatic Liquid-Cooled Couplings provide infinitely adjustable speeds for nearly every application from 3 to 150 HP. Note the absence of slip rings, brushes, and commutators. Heavy-duty types with capacities up to 5,000 HP are also available.

EATON

DYNAMATIC®

LIQUID-COOLED EDDY-CURRENT COUPLINGS and DRIVES



"Dynaspede" Drives are Dynamatic Liquid-Cooled, Stationary-Field Eddy-Current Couplings mounted integrally with standard, D-flange, squirrel cage motors. Available in capacities from 3 to 150 HP.

Here's Why—

Dynamatic Liquid-Cooled Couplings and Drives provide infinitely adjustable speed from a constant speed source—or constant speed from a variable speed source. They operate on standard alternating current. Rotary power is transmitted through the coupling by an electromagnetic reaction between the driving and driven members of the unit—there is no mechanical contact of rotating members to cause wear and require adjustment or replacement.

A wide range of standard and special control features may be obtained from a remotely-mounted electronic control system. Infinite speed adjustment, constant speed control, on-off clutch control, torque limit, acceleration control, inching, and threading are a few of the many functions available. The addition of an eddy-current brake to standard couplings or drives provides smooth, cushioned stops and controlled deceleration.

Liquid-Cooled Dynamatic Couplings and Drives deliver more horsepower than other types of the same physical size, thus conserving space in a busy machine area. Efficient heat dissipation permits continued operation at low speeds, or stall with full load.

Completely enclosed, Dynamatic liquid-cooled units are protected from dust, dirt, and other atmospheric impurities. Dynamatic design involves no brushes or slip rings; there is no possibility of arcing. With simple modification these units can be made explosion-resistant for hazardous applications.

Infinitely Adjustable Speeds from AC Power

★

Smooth, Quiet Operation from Cushioned Starts

★

Wide Range of Control Functions

★

No Slip Rings, Brushes or Commutators

★

Completely Enclosed Design

★

Greaseable Bearings

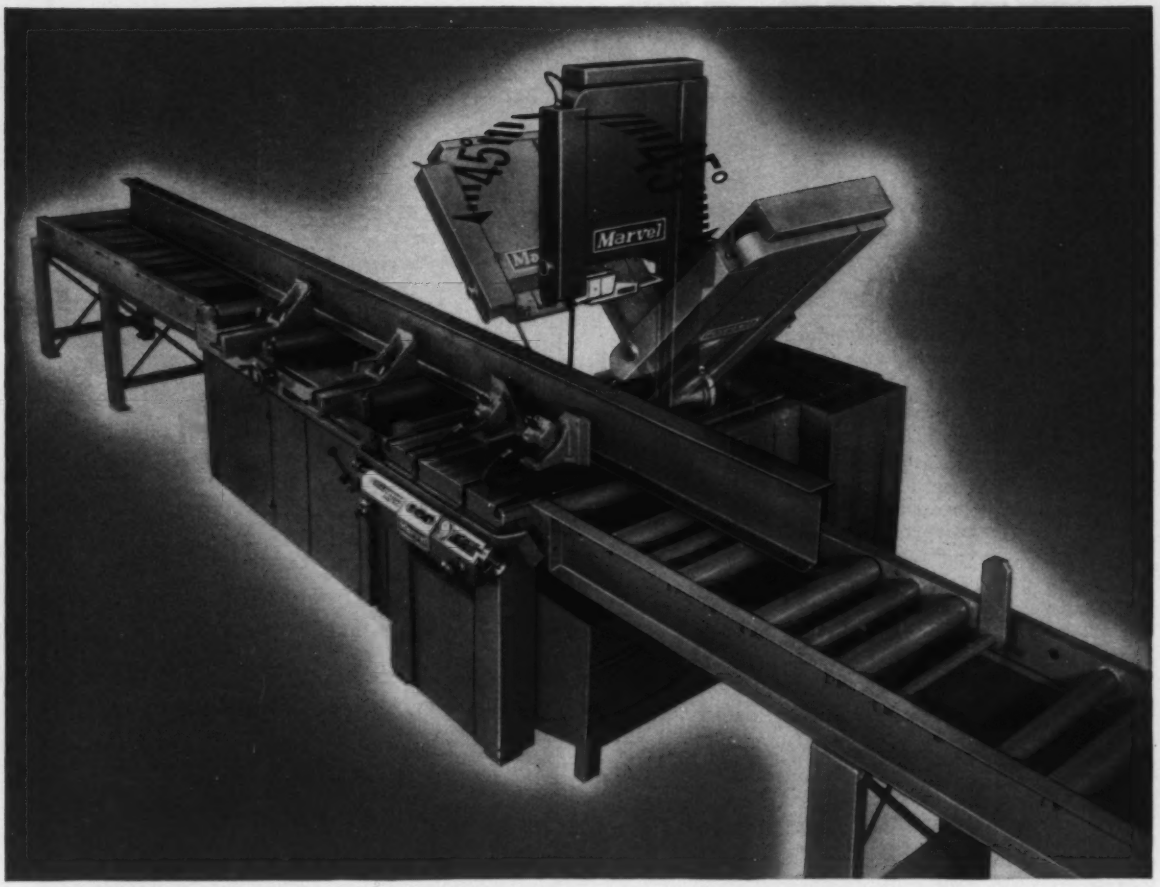
Send for Our New Illustrated Bulletin.

EATON

DYNAMATIC DIVISION

MANUFACTURING COMPANY

3122 FOURTEENTH AVENUE • KENOSHA, WISCONSIN



Tips Its Head To Cut Production Corners

Sawing 45° miters in any kind of material has always been a simple task for MARVEL Saws, but moving the work up automatically and making consecutive cuts on an angle was a problem, especially when the work was long and cumbersome.

This triple exposure photograph of a new MARVEL No. 81A All Hydraulic Heavy Duty Automatic Bar Feed Band Saw, illustrates how the upright head or column can be tipped 45° either right or left of vertical to make angle or miter cuts. The work is held stationary while the column, which carries the blade, is fed forward, meeting the work squarely to insure accurate cutting. After the cut is completed, the work is automatically moved up and measured, and another cut made.

Automatic miter cutting is just one of many exclusive universal features of these band saws. Designed to utilize every advantage of high speed steel band blades, MARVEL No. 81 Series Band Saws can handle almost any conceivable sawing job—from the smallest, most delicate work, up to 18″ x 20″ shapes.

Only the MARVEL No. 81 Band Saws have the "SURE-LINE" Automatic Accuracy Control (basic patent applied for) which literally steers a blade to make a straight cut. This unit extends usable blade life as much as 50%.

MARVEL No. 81 Series Band Saws are proving themselves daily, as the most versatile machine tools in production metalworking plants.

For complete details, or a demonstration of MARVEL Sawing Equipment, write: Armstrong-Blum Manufacturing Co., 5700 W. Bloomingdale Ave., Chicago 39, Ill.

MARVEL Metal Cutting SAWS
Better Machines-Better Blades

EUCLID

MATERIAL HANDLING EQUIPMENT

Since 1910

Euclid Cranes and Hoists are produced by specialists to render efficient service with minimum attention.

Their high quality is evidenced by a long list of discriminating purchasers and an impressive record of repeat orders.

Euclid Cranes are available in a large range of sizes and capacities. They include top running, underhung, single or double girder, motor driven or hand power, for all types of industry and service.

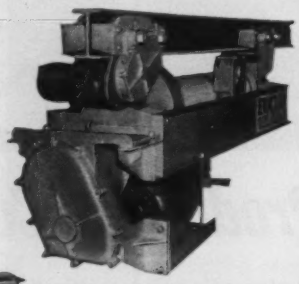
Trolleys are built with one or more hoists as required with any type of control. Top running, underhung, submerged or full revolving trolleys are available.

Special cranes are built to customers' specifications or to plans developed by our engineers.

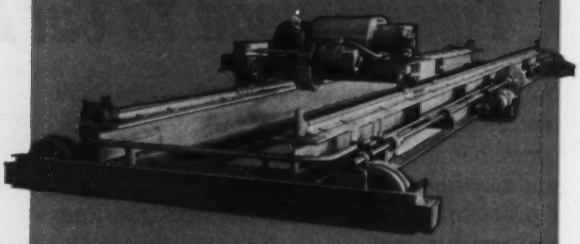
This double girder, cab-operated overhead traveling crane was built for Class 4 service.

It is one of seven Euclid cranes in operation in this warehouse.

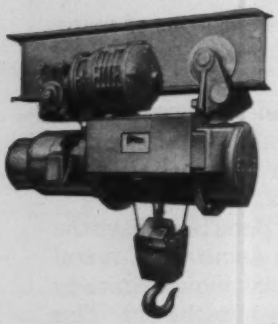
Typical machine tool assembly cranes. Crane in foreground utilized for sub-assemblies. High capacity two hoist crane in background handles small assemblies as well as the completed machines.



High lift heavy-duty monorail hoist, designed for either motor driven or hand power trolleys, may be provided with cab or floor control in capacities up to 30 tons.



Typical double girder general purpose crane composed of standard components. A wide variety of spans and capacities available with floor, cab or remote controls. Modified as desired to meet special requirements.



Series H hoists are available in 3 to 15 ton capacities in a variety of mountings to suit specific requirements.

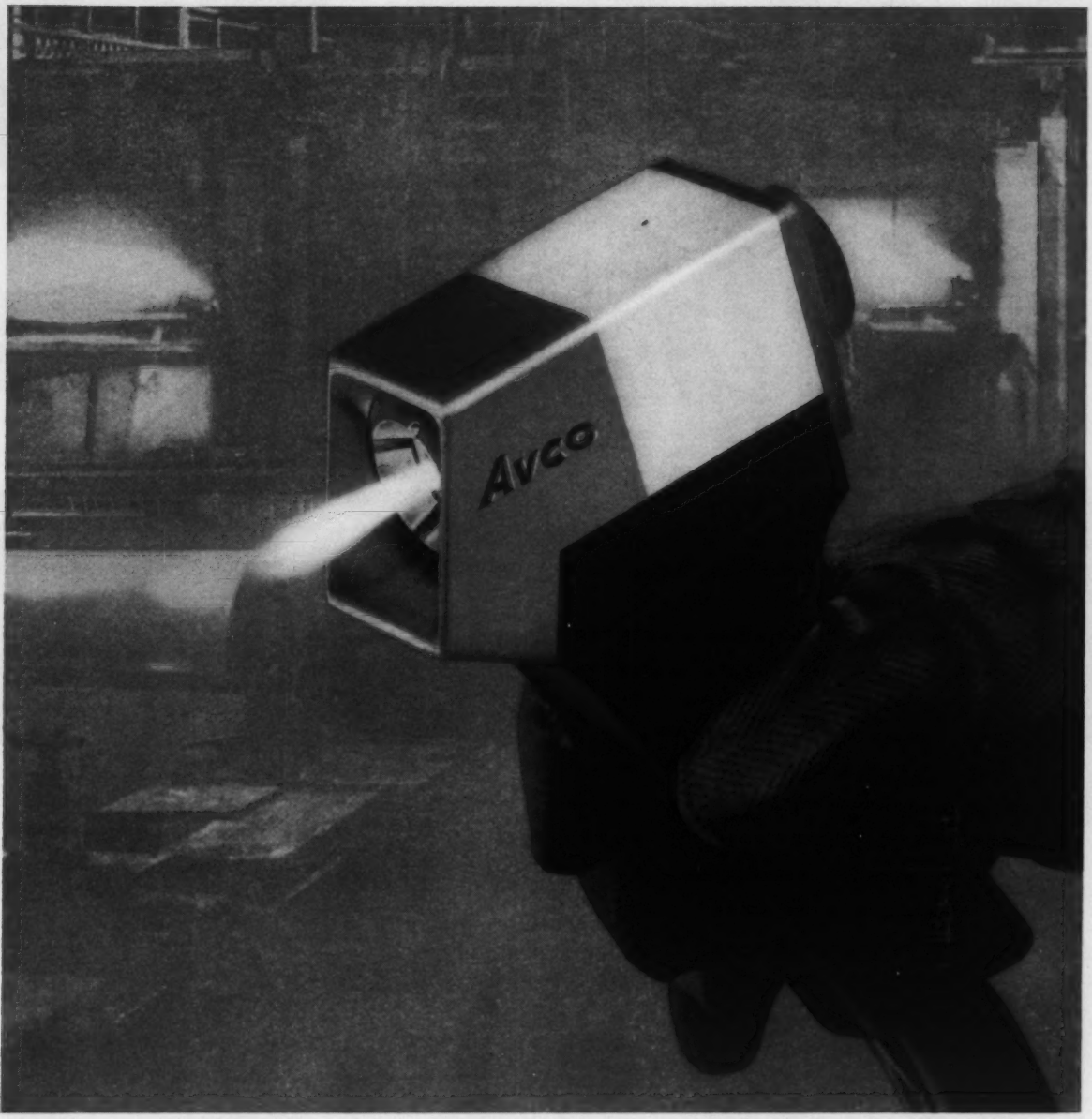
Illustrated is a parallel mounted hoist with cone gear trolley drive.

Euclid Series S Hoists feature quality at competitive prices. Work tested, time proved design. One piece combined gear housing and hoist frame of heavy steel. Easily serviced. Complete motor interchangeability. Capacities from ½ to 6 tons.

Write for the Euclid Crane Catalog

Ask for a Euclid Proposal stating the type and size of crane or hoist in which you may possibly be interested.

The EUCLID CRANE & HOIST CO. Chardon Road Cleveland 17, Ohio



Avco puts the PlasmaGun to work—in your plant

This Avco PlasmaGun spray-coats metals, ceramics and refractories with a thickness, density and bond strength never before possible—right on your production line.

It sprays uniformly without clots or streamers at roughly half the cost of other plasma equipment. And you can save up to 30% over conventional spray-coating—even more when fabricating free-standing parts from materials such as tungsten.

The Avco PlasmaGun takes powders previously too fine for other plasma equipment. The cathode is adjustable, too, for convenience and economy. (No need to switch cathodes each time you change powders.)

The cost? Lower than you think. It can pay for itself on the first job. Maintenance? Easiest of any gun in the field. (The PlasmaGun assembles with only 4 bolts!) Warranties? On all parts, for six months. (Another exclusive Avco feature.)

AVCO
Research & Advanced Development
division

Avco's special PlasmaGun booklet describes the complete system. Send for your free copy right now!

AVCO Research and
Advanced Development Division
Dept. **10-3,** Wilmington, Mass.

Please send free information about new PlasmaGun system.

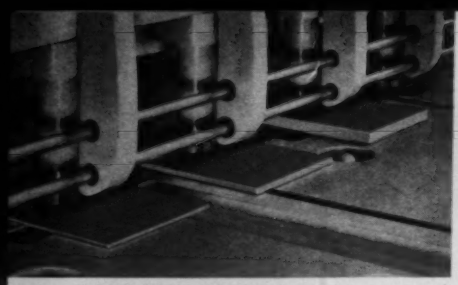
Name_____

Organization_____

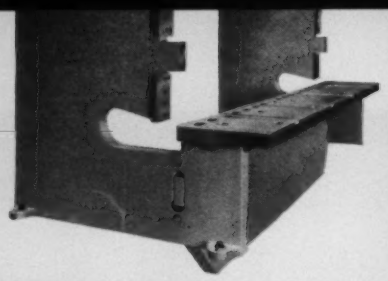
Address_____

City_____ Zone____ State_____

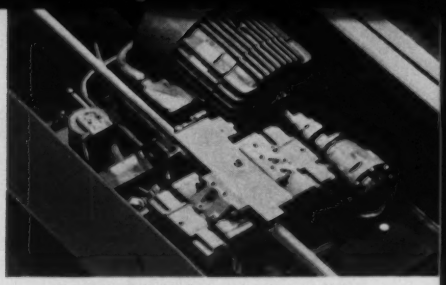
Title_____



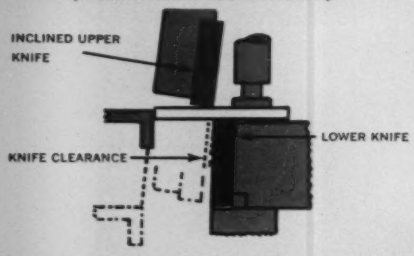
Hydraulic holddowns hold work securely.



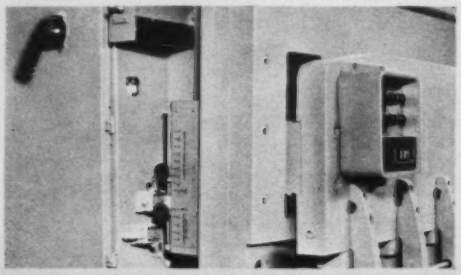
Interlocked construction eliminates load supporting welds.



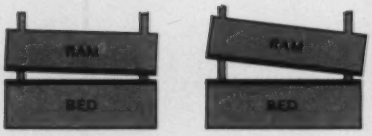
Compact manifold block replaces usual piping.



Inclined ram makes use of four edge knives practical.



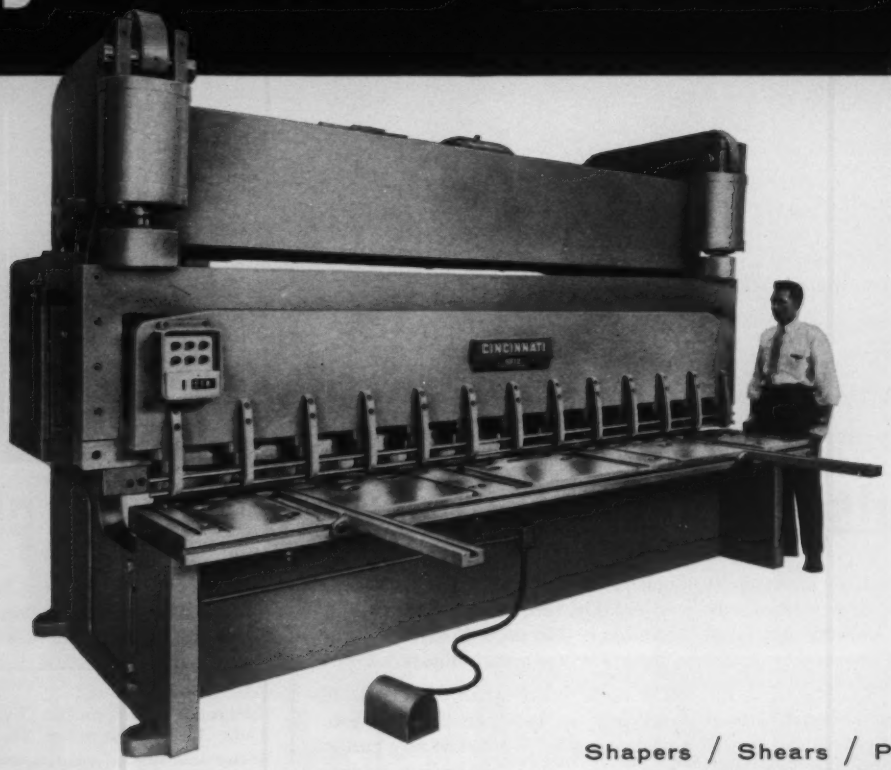
Centralized controls improve operator's productivity.



Adjustable rake gives you extra shearing capacity.

CINCINNATI®

hydraulic shears



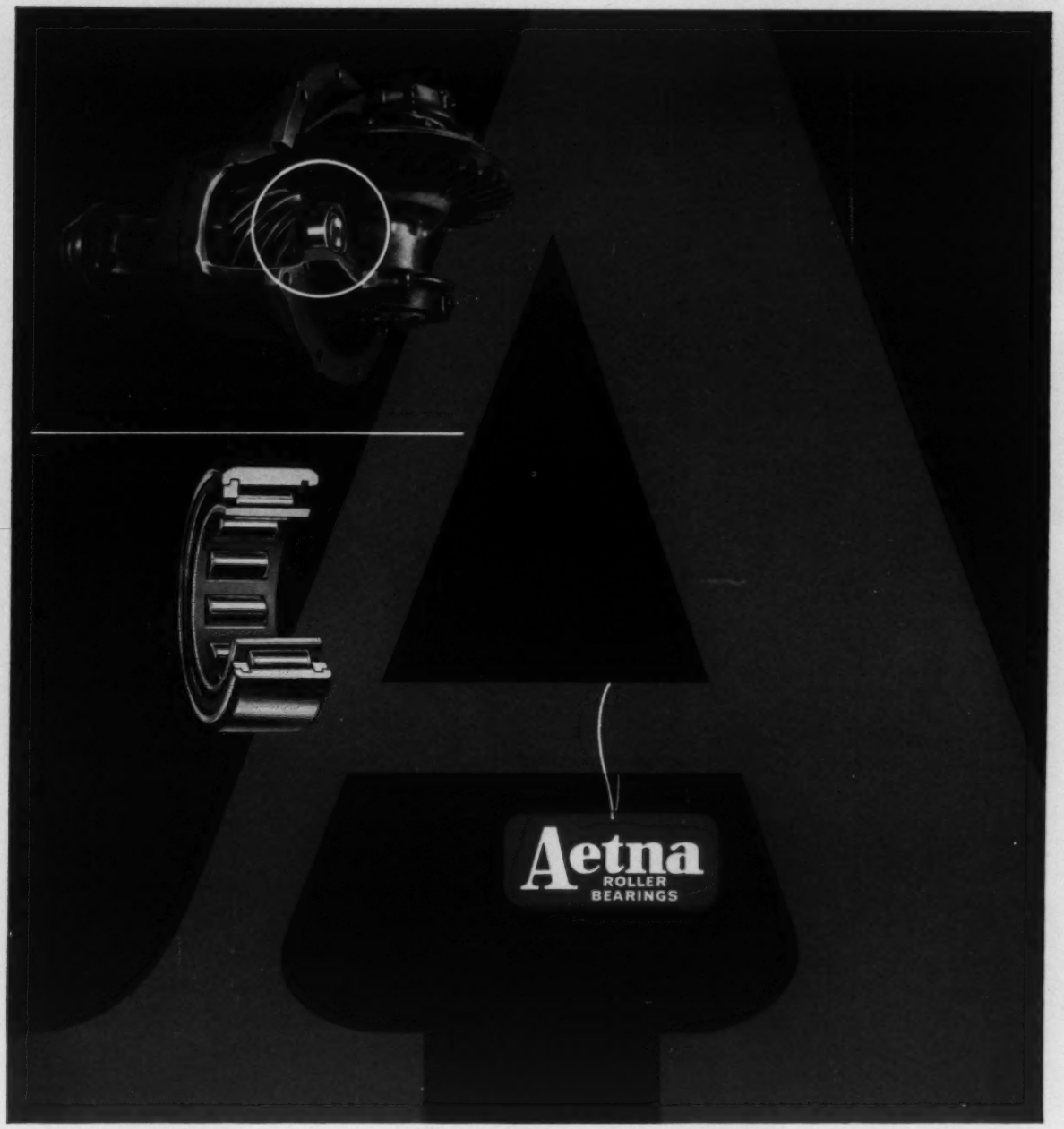
Cincinnati Hydraulic Shears include in the standard price many features which cost extra on competitive shears. Several of these are shown above. Combined with an exceptional range of shearing capacity in one frame, they make any Cincinnati Hydraulic Shear a profitable investment. Request Bulletin HS-1 for complete details and features.

Shapers / Shears / Press Brakes

THE CINCINNATI SHAPER CO.

Cincinnati 11, Ohio, U.S.A.

United Kingdom: The Cincinnati Shaper Co., Ltd., Glasgow, Scotland



FOR FORD... QUALITY, THAT'S ALL For many years, Aetna bearings have been a part of Ford cars and trucks, helping to maintain their high standards of efficiency. In many Fords, Aetna roller bearings are a vital component in the differential. Clutch release bearings by Aetna also assure smooth transfer from low to high speeds. Apply this same anti-friction efficiency and quality to your product. Aetna bearings are available in a wide range of sizes in both roller and ball types, plus many special designs in both pure radial and pure thrust. For details, call your Aetna representative listed in your telephone directory or write for General Catalog and Engineering Manual.

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ANTI-FRICTION SUPPLIERS TO LEADING ORIGINAL EQUIPMENT MANUFACTURERS SINCE 1916

A new advance in synthetic coolants

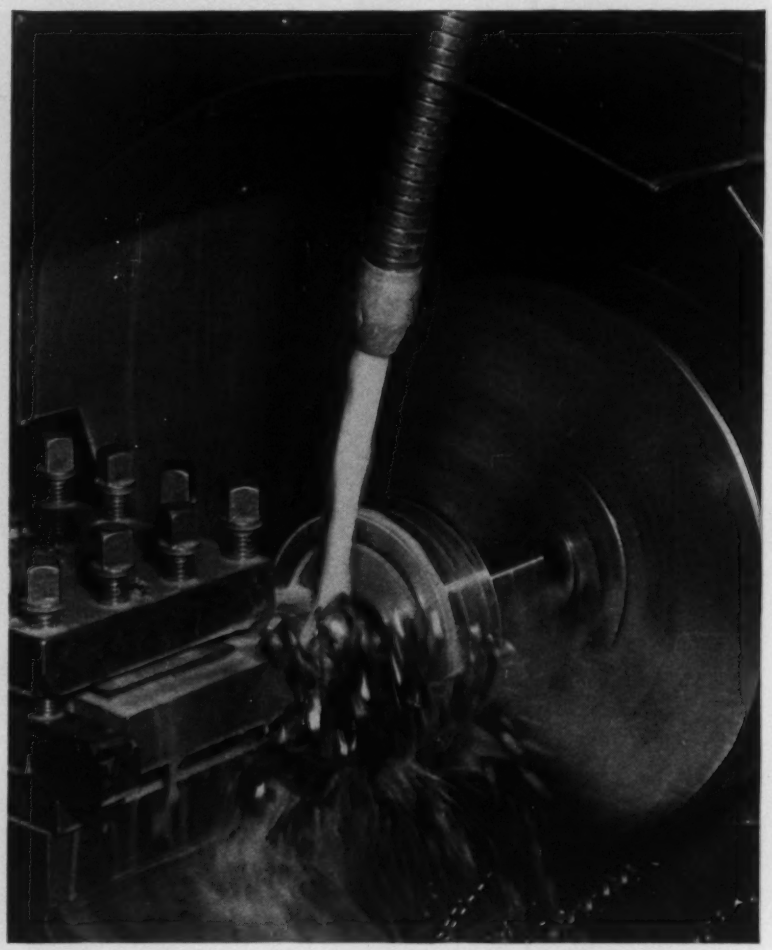
The first chemical coolants were outstanding in controlling rust and rancidity. They have done a good job and are widely accepted for many metal removal operations.

Because they were not heavy-duty fluids, our research department continued its search for a chemically-conceived coolant that could take the place of highly fortified straight oils. The result is new Hocut 3210—a significant advancement in the science of machining coolants.

Hocut 3210 is a highly fortified water-soluble concentrate. It has outstanding anti-weld and extreme pressure characteristics. As a result, it does better those jobs previously reserved for fortified straight oils. Hocut 3210 improves finish at higher speeds without sacrificing tool life. Additionally, it eliminates smoke, oil fog and inherent fire hazards.

Hocut 3210's E.P. characteristics are released by the heat of the cutting operation. This forms a barrier between the tool and the work resulting in a clean cut, free from any welding of chip to tool. Tool life is increased, surface finish improved and parts come off the machine cool enough to handle.

Its heavy duty ability makes it an ideal coolant for tough jobs such as tapping, broaching, form grinding, internal and external thread cutting, thread rolling, plunge grinding, etc.



In spite of all the outstanding features and capabilities of Hocut 3210, its cost is most reasonable. To be up to date on this latest coolant advance, write for complete data or ask your nearby Houghton Man for a test in one of your tough jobs. E. F. Houghton & Co., 303 W. Lehigh Ave., Philadelphia 33, Pa.

Houghton

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reduces production costs
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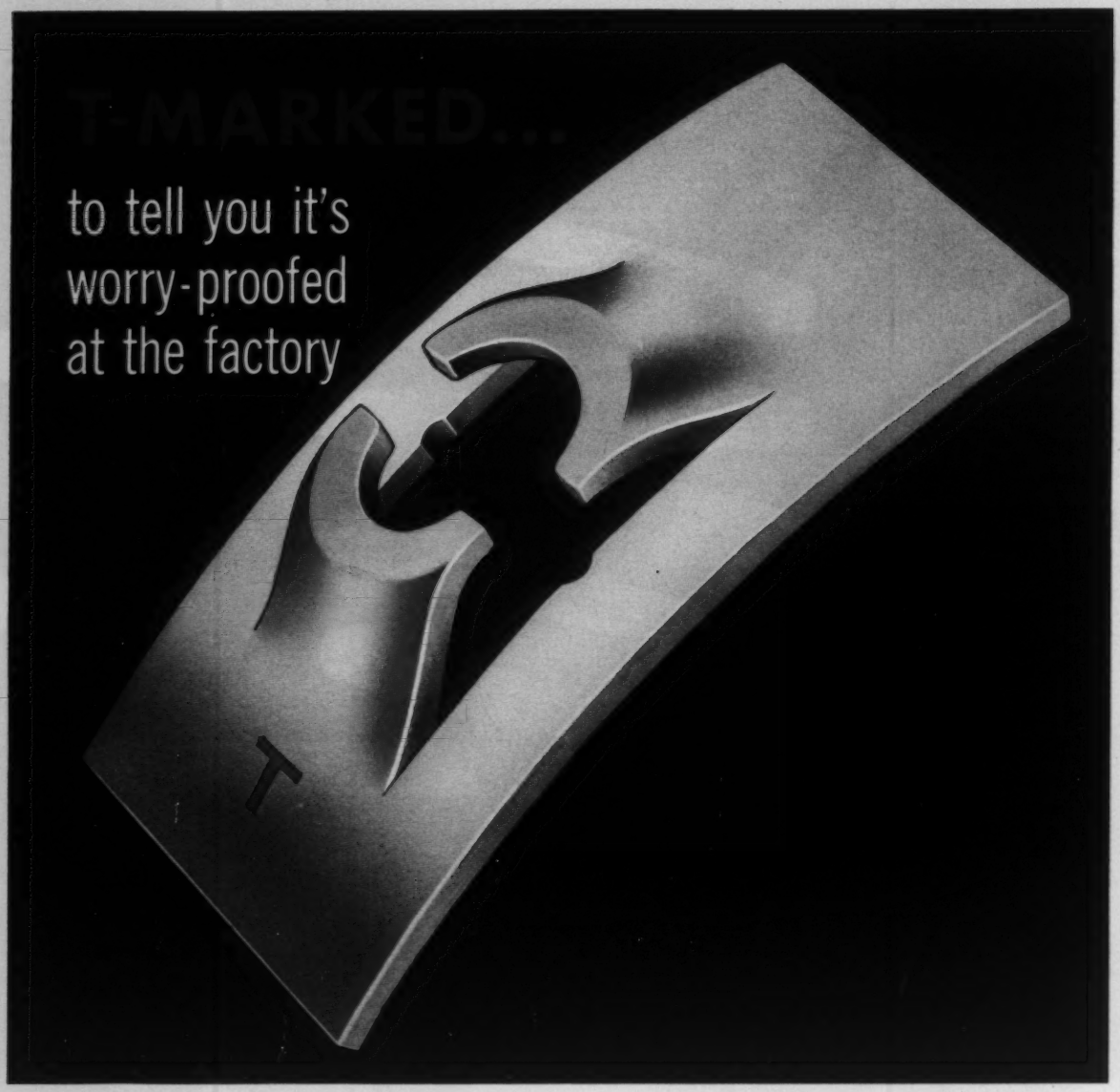
You can be sure . . . if it's Westinghouse

J-35006


T-MARKED...
to tell you it's
worry-proofed
at the factory

Other spring fasteners may look like Tinnerman SPEED NUTS. But only the *T-marked* ones really are SPEED NUTS . . . really are "Tinnermans". . . made to highest quality and precision standards to assure worry-proof performance on your assembly.

Here's what the exclusive Tinnerman T-mark means to fastener users:

Over thirty-five years of Tinnerman experience as the originator and largest producer of spring-steel fasteners...the leader in solving your fastening problems,

Outstanding fastener design and production experience that assures you the best possible design of SPEED NUT, whether it is a special SPEED NUT or one of the 10,000 SPEED NUT brand fasteners presently available,

Stringent control of SPEED NUT quality from coil strip to you, including die design, production, heat treatment and finishing.

Be sure you specify "Tinnerman T-marked SPEED NUTS" that give you better fastening, that cut parts and assembly costs, that never let you or your customer down. *Tinnerman Products, Inc., Dept. 12, Box 6688, Cleveland 1, Ohio.*

CANADA: Dominion Fasteners Ltd., Hamilton, Ontario.
GREAT BRITAIN: Simmonds Aerocessories Ltd., Treforest, Wales.
FRANCE: Simmonds S.A., 3 rue Salomon de Rothschild, Suresnes (Seine).
GERMANY: Mecano Simmonds GMBH, Heidelberg.

T TINNERMAN *Speed Nuts*®
Look for the Tinnerman "T"

Our shoes come off like slippers

Just a turn of a wrench and off slides the shoe—and only the shoe. No loose hardware, no screws, bolts or nuts to lose. Shoe removal is really simple on Clark Brakes.

Replacing them is equally simple. Shoes are symmetrical, identical—fit either side, either end up... a Clark exclusive. Unique, heavy-duty shoe fastening knuckle provides shoe self-alignment and permits shoe replacement from either side.

This is only one example of how simple maintenance was designed into this "mill man's" brake to do a better job on the job. Try a Clark Brake on your next installation and see for yourself. 61MB1

HERE'S WHY CLARK AISE-NEMA BRAKES ARE FIRST CHOICE...

- Magnet hinged at top... dirt tends to fall through because widest part of magnet gap is at bottom
- Coil case easily removable without dismantling brake or even disturbing adjustments
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- Maintenance adjustment conveniently made from top
- Wheel and motor armature easily removable
- Self-aligning shoes assure even lining wear
- No special tools needed for maintenance or adjustment
- Eight sizes, 8" to 23" wheel diameters

THE CLARK CONTROLLER COMPANY

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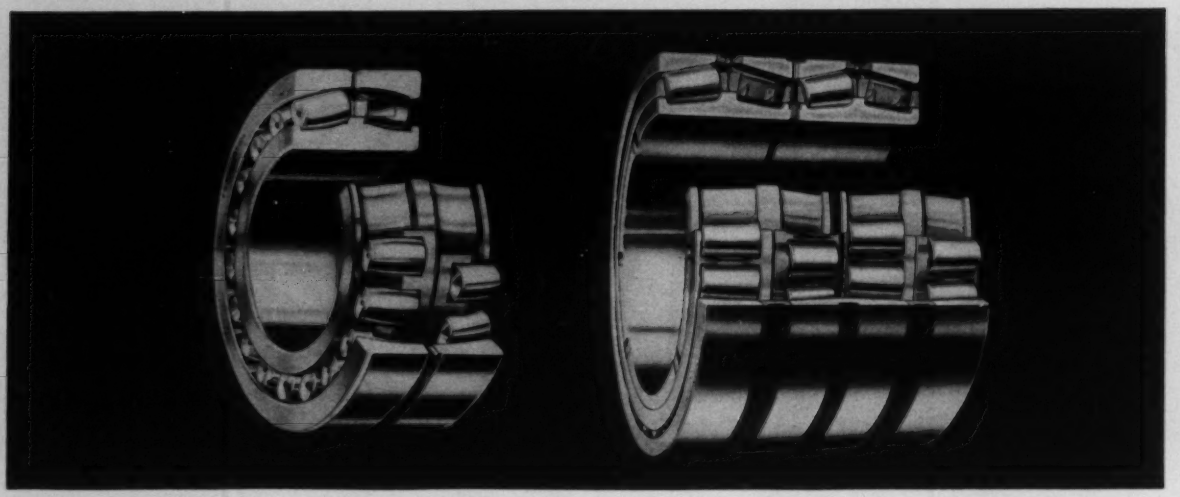
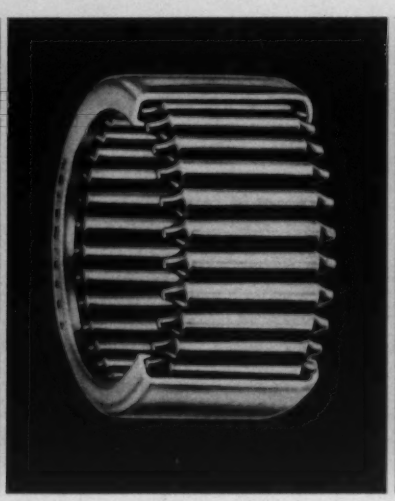
YES, TORRINGTON IS A LEADING MANUFACTURER OF LARGE ANTI-FRICTION BEARINGS...

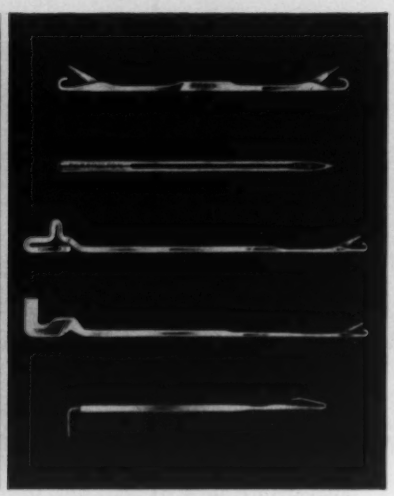


BUT THIS, TOO, IS TORRINGTON...

Foremost producer of small precision metal parts, manufactured by the millions to meet the mass demands of a variety of industries.



Pioneer manufacturer of the revolutionary needle bearings now used in countless products, from aircraft to home appliances.



America's largest manufacturer of machine needles for knitting, sewing, tufting and felting... and a leading producer of surgeons needles.

In these and many other fields throughout the world Torrington is contributing to

PROGRESS THROUGH PRECISION

THE TORRINGTON COMPANY

Torrington, Connecticut

Serving industry from plants located in the United States, Canada, England, Germany and Italy

"PASSING THE BATON"—FROM WHITING TO WHITING

The big Whiting Distributing Ladle has been storing the melt. Slag, rising to the top, has hardened to form a natural lid and retain the heat below. Now the "baton" — a stream of slag-free metal — is passed through the outside teapot spout into a Whiting Pouring Ladle with bottom tap for final relay to the molds.

This scene is typical of efficient foundry operations throughout the world. Whiting engineers, practical foundrymen themselves, have designed more than 200 types and models of metallurgical ladles to reduce costs, speed output and improve casting quality in every pouring operation. If you have a special need, they'll design a special ladle to meet it precisely. And there is no charge for this service. See your local Whiting rep or write direct.

FREE: Bulletin FY-163-R, *WHITING-LADLES.* Forty pages of illustrated ladle models and accessories to cut your casting costs. Write for it today. *Whiting Corporation, 15643 Lathrop Avenue, Harvey, Illinois. In Canada: Whiting Corporation (Canada) Ltd., 350 Alexander Street, Welland, Ontario, Canada.*

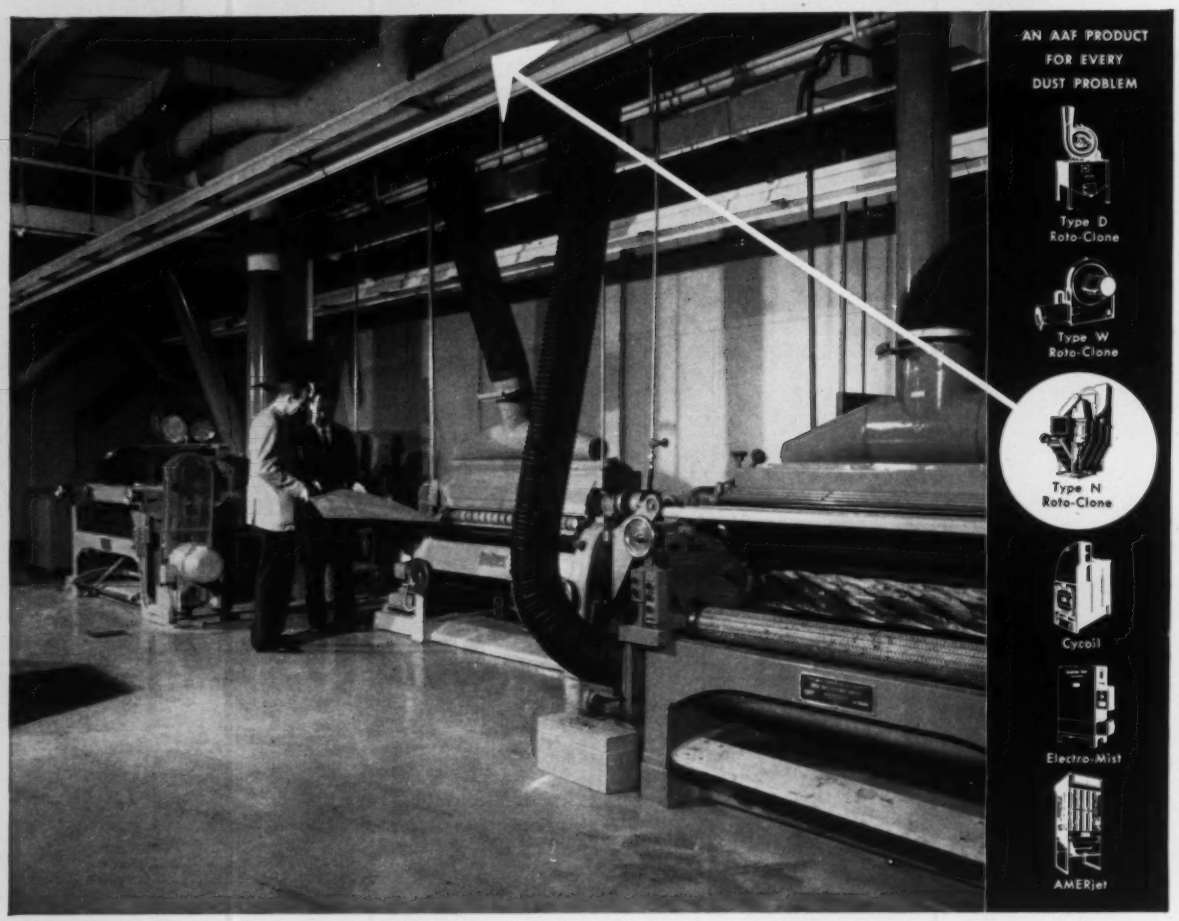
90 OF AMERICA'S "FIRST HUNDRED" CORPORATIONS ARE WHITING CUSTOMERS

WHITING

FOUNDRY EQUIPMENT

MANUFACTURERS OF CRANES; TRAMBEAM® HANDLING SYSTEMS; PRESSUREGRIP; TRACKMOBILES®; FOUNDRY, RAILROAD, AND SWENSON CHEMICAL EQUIPMENT

POLISHING



AAF Type N ROTO-CLONES keep polishing operations dust-free

● This sparkling clean polishing area proves that flat-stock polishing need not necessarily be a dirty business. With AAF's wet-collecting Type N ROTO-CLONES continually snuffing out the dust threat, maintenance costs go down, employee morale and productivity go up.

AAF's complete line of dust control equipment was application-developed, now challenges *any* metalworking dust problem, regardless of the metal. Where are troublesome dust, fumes or mists causing you trouble – grinding, buffing, polishing, plating, dry machining, wet machining, heat treating, abrasive cleaning? All can be effectively and economically controlled by AAF.

For the answer to your polishing dust problem, call your local American Air Filter representative, or write direct for Type N ROTO-CLONE Bulletin 277. Address Mr. Robert Moore, American Air Filter Company, Inc., 443 Central Avenue, Louisville, Kentucky.

AAF American Air Filter
BETTER AIR IS OUR BUSINESS

Stop looking for spring wire in large coils...it's here (*courtesy of Roebling*)

This is really an enormous availability—3000 pounds of high carbon spring wire in a single, nonstop coil. You know what this means. Uninterrupted productivity. You make more of your products faster and, as with *any* length of Roebling spring wire, you make them better.

Another happy availability (also in large coils) is new Roebling Springkote* Wire. Springkote runs through feed rolls without slippage, stress relieves more uniformly and takes finishes better—yet costs no more than lime-coated wire.

For information on this ready abundance and on new Roebling Springkote, write Roebling's Wire and Cold Rolled Steel Products Division, Trenton 2, N. J.

*Reg. applied for

ROEBLING

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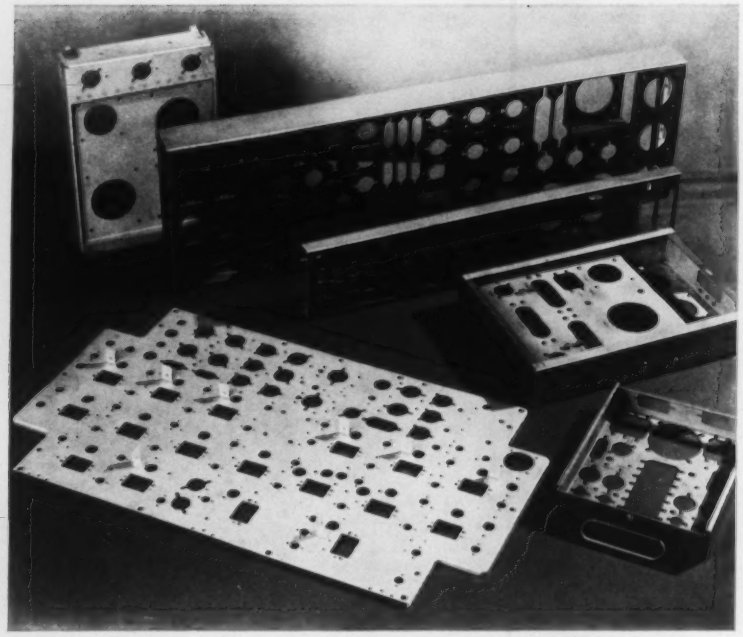
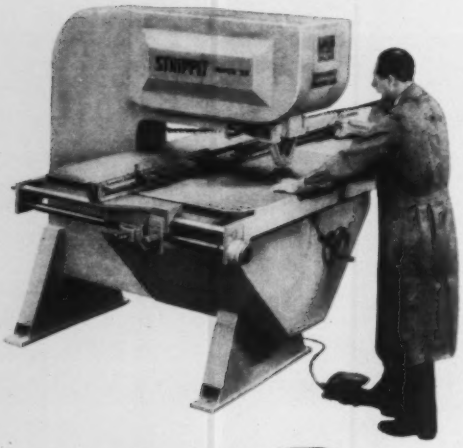
John A. Roebling's Sons Division
The Colorado Fuel and Iron Corporation

SEE OUR EXHIBIT AT THE
1961 DETROIT METAL SHOW
OCT. 23-27

COME AND SEE US AT BOOTH 130



PUNCH COMPLICATED PATTERNS FAST WITH STRIPPIT FABRICATORS



SUPER 30. Handles flat or formed workpieces 60″ wide...any length. Both the Super 30 and the 15A punch round and shaped holes up to 3½″ diameter, to ¼″ thick material...notch 90° corners—rectangular, radii, vee and special shape edge notches —up to ⅛″ capacity...nibble straight line or contour shear up to 38″ diameter circle, at 165 strokes a minute in ⅛″ material.

STRIPPIT DUPLICATOR
For low cost production runs on the Super 30 or 15A, the STRIPPIT Duplicator functions like a pantograph to reproduce any hole pattern from a drilled or punched template. No custom dies needed to turn out precision sheet metal parts.

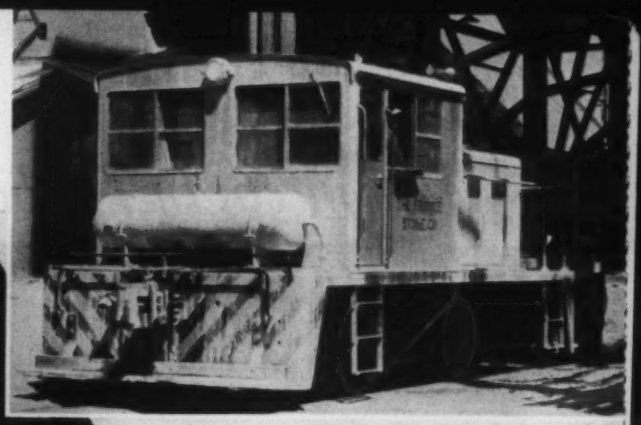
NEW 15A. Designed for workpieces up to 30″ wide...any length...the new 15A Fabricator offers all the speed and accuracy of the Super 30. Each machine, with its own universal tool holder, makes it possible to interchange standard and special tools in seconds to minimize down-time. Flat punched parts produced require no deburring. Multi-stop micrometric gaging system positions work rapidly to exact layout specifications.

WALES **STRIPPIT** INC.
210 Buell Road • Akron, New York

UNIT OF HOUDAILLE INDUSTRIES INC.

In Canada: Strippit Tool & Machine Company, Brampton, Ont.; In Continental Europe: Raskin, S. A., Lausanne, Switzerland; In the British Isles: Kearney & Trecker—C. V. A. Ltd., Hove, Sussex, England

The smooth, steady power of this Plymouth Diesel Hydraulic Locomotive assures dependable, capable in-plant haulage at the Indiana quarry of a leading stone company. A total of nine Plymouth Locomotives are in service with this company in their widespread quarry operations.



Plymouth proves its power in rugged quarry hauling

Leading quarry operators everywhere rely on the smooth, dependable power of Plymouth Locomotives for their track haulage, the backbone of quarry production. With peak efficiency, they get the extra bonus of substantial fuel savings and minimum maintenance costs.

See for yourself how Plymouth Diesel Locomotives can improve your material handling operations and save money. There is a standard model exactly fitted to your operations, weights from 3 to 100 tons with power matched to each size. An outline of your haulage operation is all that's needed for Plymouth engineers to give you a *cost-cutting analysis*.

Contact Plymouth Locomotive Works, Division of The Fate-Root-Heath Co., Dept. A-1, Plymouth, Ohio.

PLYMOUTH® LOCOMOTIVES

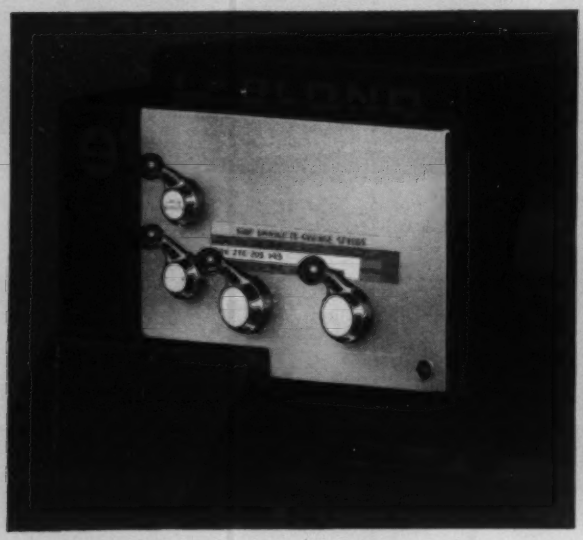
WITH TORQOMOTIVE DRIVE®

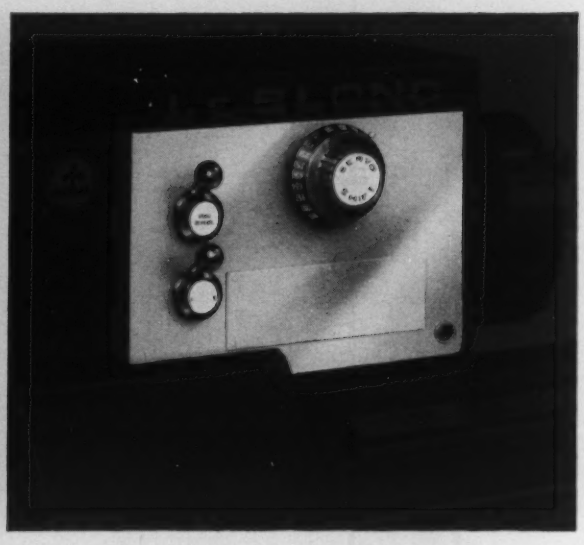
*Torqomotive Drive: Plymouth Transmission coupled to a Hydraulic Torque Converter.

RAIL POWER

PLYMOUTH LOCOMOTIVES in Progressive Industry throughout the world

new concept in Lathes





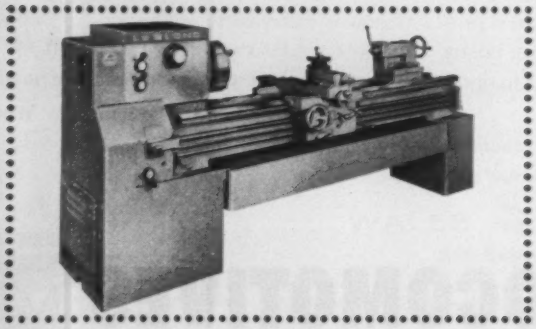
buy REGAL with manual shift ... add SERVO-SHIFT later!

Are you dubious about the advantages of hydraulic shifting on small lathes? Ingenious design of the new LeBlond Regal headstock lets you start with manual controls and add hydraulics in your shop at any time in the future! It's like having your cake and eating it, too.

The cost of adding the Servo-Shift package in the field is modest — just slightly more than original factory installation.

Brand new Regal Servo-Shift makes speed changing faster and easier than ever before. You select your next spindle speed while still cutting. Then move the control lever to brake position and get almost instantaneous automatic shifting — *with no clashing of gears!* This is the fastest and safest hydraulic shift available in a lathe today! It's simple and foolproof! It will make a hero out of every operator!

Our new Regal — the low-cost lathe with big-lathe features — has many more important advantages *not available in any other machine* of the same class. Ask us to have a LeBlond field engineer stop and tell you about them, or write for our new descriptive Bulletin R-961 B.



World's largest builder of a complete line of lathes.

LeBLOND of Cincinnati

The R. K. LeBLOND
MACHINE TOOL COMPANY
Cincinnati 8, Ohio

More Benefit from Fringes

An electrical maintenance man, with wages of $6200 a year, quit to take a similar job with another company at a pay scale that would bring him $6800 annually.

Actually, the worker probably won't make out as well financially with the second company as he did with the first. In Job No. 1, he was getting fringe benefits worth $2100 annually, so the position could be valued at $8300, not $6200. In Job No. 2, he was getting benefits worth only $1600 a year, so he had an $8400 position. However, federal income taxes would take more from his direct pay in the second job than in the first.

The first employer lost a good worker by failing to sell its employee benefits. For example, the company said little about its income continuation policy for his job class—he was covered for as long as six months out of a year if he was away from his job because of illness or accident. Such quasi-insurance can't be bought. If it could, it would cost a minimum of $550 a year.

U. S. metalworking generally has been lax in selling the value of its employee benefits. Management will have to do a better job as the fringes climb. They amounted to 22.8 per cent of the U. S. payroll dollar in 1959, says the U. S. Chamber of Commerce. They're running 25 per cent now, estimates R. H. Hoge, director of wage and salary administration for Owens-Illinois Glass Co.

Some metalworking companies pay as much as $1 per man per hour in benefits. The worker knows they exist, but he isn't overly impressed. He doesn't see them in his pay check. Another thing: He isn't inclined to give you, the employer, credit for some benefits, notably unemployment compensation and social security.

What can you do? Du Pont has sent mock checks to employees to show the extent of benefits. Other companies have tried other means, including payroll envelope stuffers, house organ articles, and bulletin board announcements.

Mr. Hoge favors the personal, direct approach: The immediate supervisor should give the facts about benefits to the people who work for him.

Someday, the boss may discuss salary or wages with his employee like this: "We'll pay you $10,000 a year. How much do you want in cash? How much in benefits?"

John S. Morgan

ASSOCIATE MANAGING EDITOR

This is an unretouched photograph of automotive and appliance trim formed of Sharon's bright annealed Stainless Steel. While it loses some of its sparkle in the advertising platemaking process, it gives you some idea of the brilliance of this new Stainless Steel. A detailed pamphlet has been prepared. Write for your copy today.

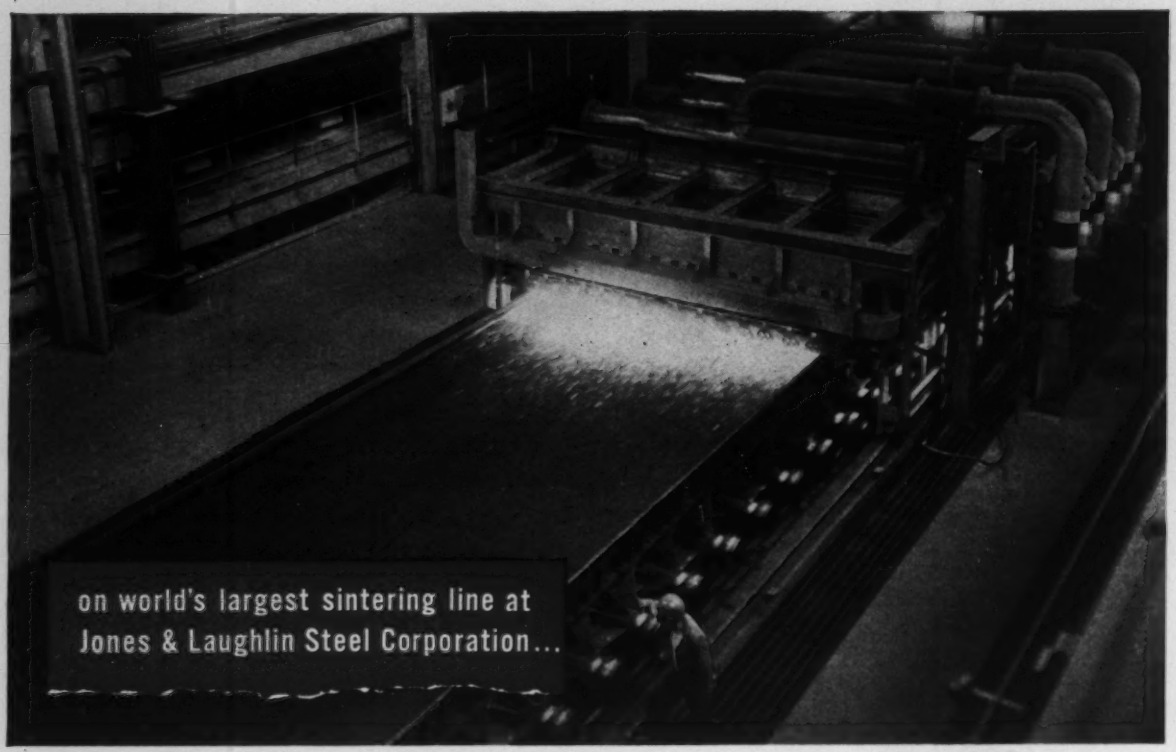
WHY DESIGNERS LIKE

The brightest, most sparkling Stainless Steels ever developed are creating unusual excitement among manufacturers of our high-quality products. Automotive engineers, appliance designers, furniture people, architects and business machine makers, to name a few, are specifying Sharon *bright annealed* Stainless Steels to a greater degree than ever before. *Bright annealed* Stainless Steel is truly the best looking metal ever made. What's more, it has excellent forming characteristics and improved corrosion resistance, and it reduces or often eliminates buffing operations on high-finish parts. To accent and enhance the appearance of your products, think of the new *bright annealed* Stainless Steels, and when you do . . . think first of the *Sharon Steel Corporation, Sharon, Pennsylvania.*

SHARON *Quality* STEEL

AMERICA'S FOREMOST PRODUCER OF LIGHT STEELS

SHARONSTEEL®



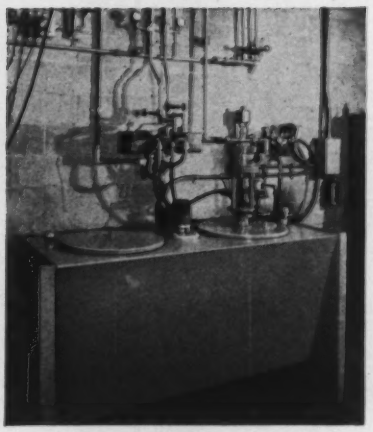
FARVAL SERVES OVER 300 VITAL POINTS OF LUBRICATION

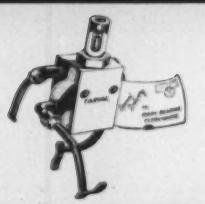
Each month, this new J & L single-strand sintering line can produce over 225,000 tons of top quality blast furnace ore charge that increases furnace efficiency as much as 20%. Keeping this highly important facility in round-the-clock operation is a single automatic air-operated Farval Dualine System (air pump and bulk supply tank shown in small photo) that dependably serves up to 200 lubrication points on the line's wind box seal. This versatile system delivers heavy oil—at a *low* 200-pound reversing pressure—every 45 seconds for a six-second pumping interval. Lubricant is contained in a bulk tank reservoir that's easily refillable from J & L's central lubrication storage. Also, three other modern Farval Systems continuously guard against failure of additional bearings on this up-to-the-minute facility.

Farval is the modern way to deliver measured amounts of clean lubricant to every bearing—at any desired, pre-determined time interval. Bearings are never missed. Amount of lubricant delivered to any one bearing can easily be varied without affecting others in the system. Guess work and hit-or-miss hand lubrication are entirely eliminated with Farval on the job.

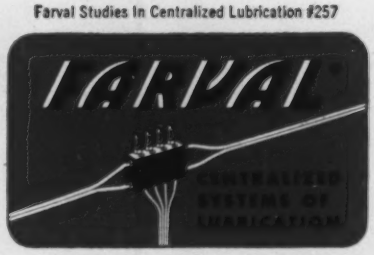
Write today for your free copy of our newly revised literature which gives the complete Farval story—shows how you can increase production, cut operating costs and boost your overall profits. Or, contact your local Farval representative—he's as near as your telephone.

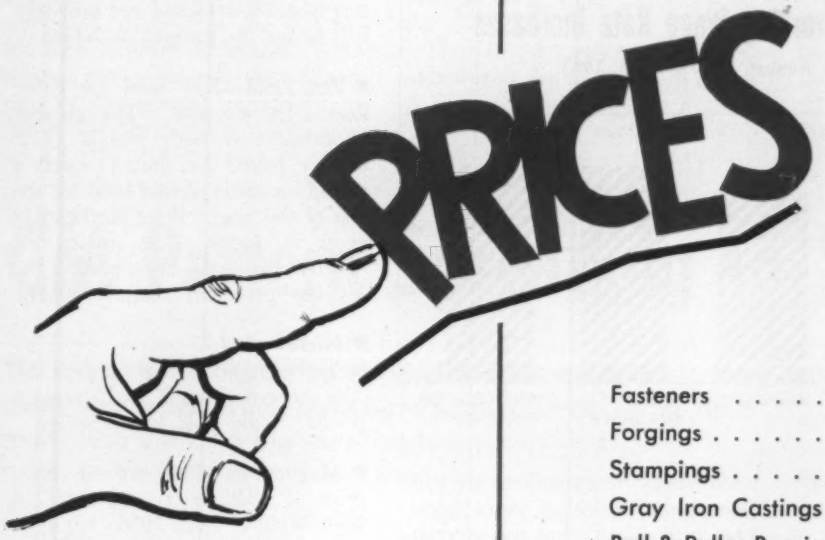
Farval Division
Eaton Manufacturing Company
3291 East 80th Street • Cleveland 4, Ohio





Farval Studies In Centralized Lubrication #257





Recent Increases Reported

Fasteners	4½%
Forgings	4%
Stampings	3%
Gray Iron Castings	3%
Ball & Roller Bearings	2 to 5%
Voltage Regulators	5%
Heavy Machinery	8%
Beryllium Alloy Products	2%
Machine Tools	2 to 6%
Aluminum Siding	8 cents, lb
Steel Finishing Equipment	2½%
Ferrochromium	5%

Pressures Mount, Prices Creep Up

DESPITE ALL the pressures—from government, foreign and domestic competition, and customers—prices are creeping upward.

In a spotcheck across the nation by STEEL's editors, 30 per cent of the metalworkers contacted said they have raised prices in the last six months; 60 per cent plan to increase them in the near future.

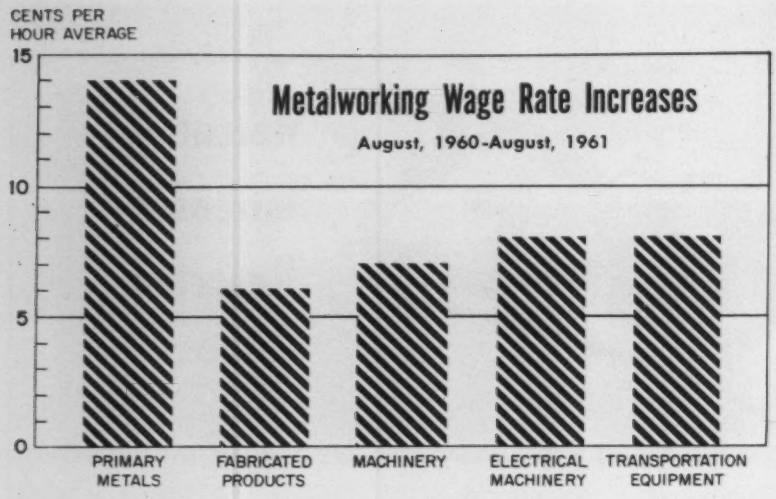
Mounting wage costs are blamed for practically all the upward pressure. Labor costs of metalworkers have climbed 11 per cent in the last three years—increases have ranged from 6 to 14 cents per hour in the last year, not counting pay hikes being negotiated in the auto industry, or the automatic, Oct. 1 pay boost for the steelworkers. Profits have not kept pace.

A Cleveland machine tool builder expresses the typical attitude: "Fierce competition has kept prices stable up to now, but industry has reached the end of its rope. We can't absorb increased labor costs, plus the increased costs of materials and components."

• **Spotlight on Steel** — And steel producers—whether they like it or not—are cast in the key role in the pricing drama. A good case can be built to support the steel industry's contention that prices rise despite its efforts to hold the line, and thus it cannot be tagged with the major role in an inflationary spiral.

But STEEL's editors found that many metalworkers are ready to make the steel industry the scapegoat if it boosts prices. Look for many firms to announce price hikes which will more than offset the increased price of steel—yet steel will be blamed. Example: A Chicago stamper admitted privately: "If the business upturn materializes (I've got lots of optimism but few orders) and steel boosts prices, we'll try to compensate for the added costs plus a little extra to try to get back toward a 'normal' profit range again."

Nearly 75 per cent of the executives polled, including many who have already announced increases, say they'll boost prices if steel costs go up. One Pittsburgh forger reports: "We've already informed



our customers that we will immediately pass along any steel price increases."

• **Some Cut Prices** — Laments a large manufacturer of electric motors: "A steel price increase would have severe impact on us because much of the cost of a motor is in the steel. We buy high priced electrical steels—and they're likely to go up as much as or more than other grades." The electric motor industry is one of the few in which price reductions have been made this year. Price cuts of 5 to 7½ per cent were announced recently, and one manufacturer says the trend has been downward all year "and the bottom hasn't been reached yet."

Those who expect to be hit the hardest by a steel price increase include the makers of machine tools, material handling equipment, fasteners, forgings, and stampings. An Eastern conveyor maker said he cut prices 5 per cent recently, but he will have to raise them again if steel costs go up.

• **Contrast** — Many people are in sympathy with the steel industry's position. The First National City Bank, New York, said in its October business letter: "The buyer of steel must pay for its cost of production. The nation's taxpayers cannot afford to have the steel industry . . . forced to go to Washington as supplicants for subsidies."

• **Odds Still Favor Hike**—The failure of the market to develop sufficient vigor to take a price hike has undoubtedly dampened the steel industry's hopes for an early boost. The third quarter was not especially good, and the present one is off to a disappointing start because auto production is held up by strikes.

But the odds still favor a price increase—in due time. Look for any upward revisions to be selective, modest, and as unobtrusive as possible. Some items may even be shaved a little—Allegheny Ludlum Steel Corp., Pittsburgh, last week cut prices on two grades of specialty alloy steel.

After the flurry created by the recent aluminum price cuts, you can expect list prices of most nonferrous metals to remain fairly stable for the balance of this year. Price cutting will continue, but it should be less severe. Here's a rundown:

• **Aluminum**—The primary ingot price was reduced 2 cents a pound last month, and most mill product quotations were trimmed 0.5 to 1.5 cents a pound. Price cutting in most aluminum products has been so severe in recent months that little if any profit has been made from them. Price fighting probably won't stop, but it should ease up considerably over the next few months. At its first opportunity, the industry will raise quotations.

• **Copper** — The present producer price of 33 cents a pound should hold over the year. Demand is good in this country, so-so overseas. Lately, the overseas quotations have been weakening, but most observers don't look for the development to sharply affect the U. S. market. Brass mill product prices have strengthened some, but price cutting is still widespread and probably will be for the foreseeable future.

• **Zinc-Lead**—Zinc sales are good; lead sales are fair. The current quotations on both metals (11.5 cents a pound for zinc, 11 cents a pound for lead) should hold for the rest of the year. Price cutting still exists in special high grade zinc and the diecasting ingot grades, but it's less prevalent than formerly.

• **Nickel**—A 7.25 cent a pound increase went into effect on June 30. The current price of 81.25 cents a pound should hold for sometime.

• **Magnesium**—The present ingot price of 35.25 cents a pound has been in effect since 1956. No early change in this price is expected despite the cuts in aluminum.

Heating Equipment Market Shows Gains

INDUSTRIAL heating equipment makers expect shipments to reach $285 million this year, and there's a good chance the 1962 level will be higher.

Orders received in the first half of 1961 ran slightly ahead of the 1960 pace—$276 million. The prospect: With a business pickup in the second half, new orders could top out at $286 million.

• **Trends**—Here's how the Business & Defense Services Administration (BDSA), reports the trends in shipments by 259 companies:

Year	Value (000)
1957	$307,772
1958	252,938†
1959	236,598
1960	302,390
1961	285,000*

†221 companies.
*BDSA estimate.

With orders exceeding shipments and with a high carryover of unfilled orders from year to year ($120.7 million at the end of 1960),

the industry could prove to be a bellwether for the capital equipment segment of metalworking. BDSA says many companies are still using aged heating equipment. One private survey indicates that 52 per cent of the heating equipment in use is ten years old or older, and 12 per cent is more than 20 years old. Another indicator: Sales of replacement and repair parts totaled $45 million in 1960, almost double the 1958 figure.

The BDSA cites technological advances in the treatment of metals as spurs that will increase demand for new heating equipment with greater accuracies, more sophisticated atmospheres and higher maximum temperatures.

Foreign orders totaled $22.7 million in 1960. Shipments abroad have been increasing, with Canada, the chief market, taking up $5.3 million in equipment during 1960, followed by Japan with $3.5 million and Mexico with $2.5 million.

GM Pattern Spreading to Suppliers

The labor terms are being applied despite resistance. Not many smaller contracts have been signed. Most of the firms mark time until the big auto pacts are completed

MOST AUTOMOTIVE supplier companies are operating under contract extensions or otherwise marking industrial relations time as they wait for the United Auto Workers to wind up negotiations with the car companies. (For a rundown on the situation at Ford, Chrysler, American Motors, and Studebaker-Packard, see Page 95.)

Only a few suppliers whose contracts come up for renewal currently have settled so far. Among those who have signed, only a few companies have veered from the Genral Motors pattern.

• **Small and Early**—The nonpattern supplier contracts were often signed just before GM settled and involved smaller firms. The pacts bear out the industrial relations adage: Better to be small and early than large and late.

Associated Industries of Cleveland reports that the ante-GM settlement level was 7 cents in wages and 2½ cents in fringes per man per hour per year in northeastern Ohio, an area that mirrors national averages. The level will become higher now that GM contracted for increases in the 12 cent range.

• **Few Supplier Strikes**—Ken Porter, research director of Employers Association of Detroit, says the UAW appears reluctant to push to a strike stage with many suppliers, particularly the smaller ones. He estimates that less than 10 per cent of companies dependent on the auto business in the Detroit area have signed.

Watch the Detroit Tooling Association, which is bargaining for 57 of the 160 shops in its membership. Its agreement with the UAW expired Oct. 1. Members are working on an indefinite extension. No strike deadline has been set, nor is one expected.

• **Tool Business Off**—The shops in the association are working at about 10 per cent of capacity now, say owners, although DTA reports 47 per cent of its 10,000 man labor force is employed. The negotiations involve about 5000 workers.

DTA's initial proposal to the union asked for an 8 cent wage cut, but its real goal is to try to eliminate some of the indirect labor costs involving seniority, unemployment compensation, and job classifications. Profit sharing has not been considered by the DTA negotiators. Several of the member shops have their own profit sharing plans. The DTA agreement usually sets a pattern for other automotive tool and die shops. Probably for that reason, federal mediators are sitting in on the discussions.

• **Supplier Examples**—Here's a sampling of the labor situation in a few other key firms supplying automakers:

Bendix Corp.'s UAW contracts covering 13,000 workers in eight divisions expired Sept. 15. The plants are operating under contract extensions with five day notice of termination. They're waiting for Ford and Chrysler to settle before they do so, probably in the GM pattern.

Budd Co.'s Automotive Div. is also operating under a contract extension with a five day notice. Its contract expired Oct. 1. Look for it to settle in the GM pattern too.

Eaton Mfg. Co. is negotiating with five locals of the UAW for a contract to replace the old one which expires Oct. 29. Satisfactory progress has been made on the local level, but the international representatives are too preoccuppied with Chrysler to give Eaton much attention yet.

Midland-Ross Corp. has signed a pact with the UAW that closely follows GM terms for 1200 Midland employees in Cleveland.

• **The GM Pattern Spreads**—You can already see the GM pattern spreading beyond supplier firms too. White Motor Co. signed on substantially those terms with its truck-making employees. So did Deere & Co. for its 17,000 farm implement workers.

Negotiations between the UAW and International Harvester Co. were recessed indefinitely as of last week. The contract expired Oct. 1, but 32,000 UAW members were still on the job.

Allis-Chalmers Mfg. Co. has started prenegotiations with the UAW to set up an agenda for the negotiation meetings. The UAW has bargaining rights in eight Allis-Chalmers plants, covering 11,000 persons. Caterpillar Tractor Co. is negotiating on a plant-by-plant basis with the UAW. In four of the five plants in which the UAW has bargaining rights, the contracts have been extended indefinitely, with five day termination notice. The Decatur, Ill., plant has been closed by a wildcat.

Target: Cut F-105D Costs by One-Third

How Republic Aviation Grounded Costs

USING A TWO PRONGED attack, Republic Aviation Corp., Farmingdale, N. Y., has crashed the cost barrier in the production of its F-105D fighter-bomber. Over $150 million has been cut from costs over the past two years.

If the fiscal 1962 target is hit, the original goal (cutting the cost of each plane $1 million, one-third of its original cost) will be achieved.

Republic reasoned: It had to devise a program as modern as the craft it produces. The result was a two phase assault on costs:

First, an in-plant program that includes improved direct labor utilization, streamlining of inventories, value analysis, tooling overhaul, and a big cut in indirect labor costs.

Second, a highly co-ordinated program of value analysis with major venders to lower costs on the parts it buys.

For fiscal '61, Republic has chopped in-plant costs by $92 million or 48 per cent since 1959, and off-site purchase costs by $34 million or 25 per cent. An additional $28 million reduction in the cost of government furnished equipment was accomplished through co-ordinated Air Force-Republic effort.

Inside the Plant

• **Spur Human Productivity** — A primary target was to sharply increase effectiveness of lower line management and production workers. Goals are set for each work center in each department. Daily reports that compare performance with the target are issued to front line supervisors, so each supervisor can measure the performance of his crew (or department) with those of other crews (and against the target). "Because these reports are timely and illustrate the problem areas requiring its immediate attention, floor management is able to use its initiative and take immediate corrective action," says Gen. Harley S. Jones, executive vice president of Republic.

Backstopping the daily report is a weekly summary of operations that compares the status of performance against the target. Again, the report shows actual and potential problem areas and helps floor management use its initiative in solving them—often before serious situations develop. The weekly report also goes to higher management.

• **Keep Workers Informed**—Early in its program, Republic realized that no productivity program can be successful without the enthusiastic support of the workers. To help get 100 per cent co-operation, the company has installed display boards in each department to graphically illustrate how day-to-day operations compare with predetermined goals. Performance is measured against budgeted manhours. Result: Cost awareness is maintained throughout all levels

The F-105D, all weather fighter-bomber has been called the plane the Russians fear most. In one strike, a single "Thunderchief" could deliver more firepower than was expended by the entire U. S. Air Force during the Korean War. Flying at a speed in excess of 1400 mph, the plane can carry out an attack anywhere in the world from a base within the U. S. (with midair refueling).

of the organization, says George Garraway, assistant works manager.

• **Better Inventory Control**—More than 65,000 components go into the F-105D. Three years ago, on any given day, more than 700 of the parts were in short supply. The figure has been reduced to less than 20 via strenuous expediting, daily part checks, pinning down and eliminating distribution bottlenecks, and strict controls—from the release of purchase orders through each stage to assembly.

• **Prune Indirect Costs**—Republic reasoned that little could be done to chop fixed expenses like taxes, utilities, insurance, and depreciation.

But indirect costs offered a wide open field.

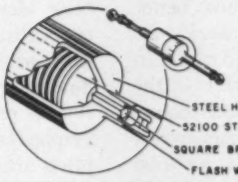
The initial step was to review the cost of operating each department and the effect each department had on the cost of the product. Target: The elimination of

How Value Analysis Boosted Savings

SAVE MONEY

Original Design

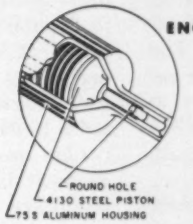
COST P/S = $ 94.00
WEIGHT P/S = 3.28 LBS.



Teamwork in Action !

ENGINEERING REVIEW - RE - DESIGN

COST P/S = $ 64.00
WEIGHT P/S = 2.26 LBS.



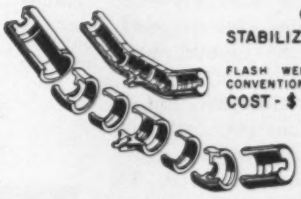
RESULTS

- SIMPLIFICATION OF MANUFACTURE
- CHANGE OF MATERIAL
- COST REDUCTION P/S $ 30.00
- WEIGHT REDUCTION P/S 1.02 LBS.

SAVE MONEY

ORIGINAL
STABILIZER CROSS BEAM

FLASH WELDED FROM TUBING & CONVENTIONAL FORGINGS
COST - $ 2140.**

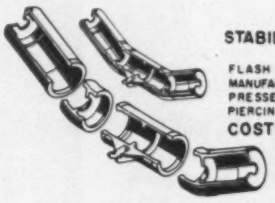


SAVE MONEY

IMPROVED
STABILIZER CROSS BEAM

FLASH WELDED FROM FORGINGS MANUFACTURED ON MULTIPLE ACTION PRESSES UTILIZING SPLIT DIES & PIERCING RAMS
COST - $ 1100.**

SAVINGS - $ 1040.** PER SHIP



SAVE MONEY

SOLE SOURCE

STAINLESS STEEL WASHERS

SUPPLIER'S PART NUMBER

$ 1.59 EA.

COMPETITION

SAME WASHERS

CHANGED TO REPUBLIC PART NUMBER

$ .09 EA.

any function not contributing to the production of a high quality product on schedule. Several benefits were realized: The streamlining and elimination of functions, better methods of processing work, revisions in organization and shifts in personnel. Even things such as the unwarranted use of company transportation came under scrutiny.

The most fruitful area for cost savings: Indirect personnel utilization. The ratio of indirect to direct labor has been trimmed from 63 per 100 to under 50 per 100. The number of supervisors has been reduced from 1 per 11.5 workers to 1 per 13.6 workers. The 1964 goal is 1 supervisor per 15 workers.

The number of indirect workers has been cut by 960, resulting in an annual savings of more than $9.3 million (including wages and fringes). Most of the personnel savings came in tool planning and control, production control, and maintenance.

Better planning and utilization of personnel have sharply cut into premiums paid for overtime. Estimated savings through 1960: $3 million.

● **Increased Value Analysis**—Added emphasis in value analysis has paid off handsomely. In one instance, value analysis engineers found that a part Republic had been paying $47 for could be produced within the plant for $3.50. In another case, the company saved $48,000 in machining costs on aluminum used for the lower wing skin. It bought blanks roughly shaped to the wing contours rather than standard rectangular plates.

Outside the Plant

To get higher quality and lower prices on the parts and equipment it purchases, Republic instituted what may be the most ambitious supplier-buyer value analysis program ever tried. The philosophy is simple: "Republic wants more business, and the best way it can do this is to put out a better product at a lower price. And if Republic gets more business, so does the supplier."

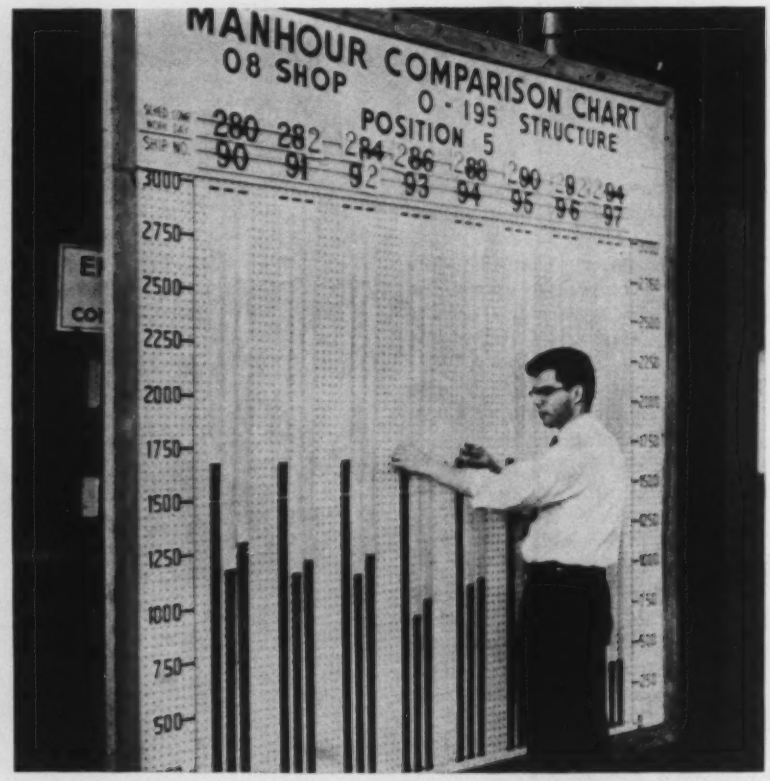
Republic called in its major suppliers, explained the program, and established cost reduction goals for each supplier. A two-way flow of ideas on value analysis was set up between Republic and its suppliers. New ideas and developments were transmitted to all venders. Suppliers were brought into the plant to see how their products were being used.

The program hit home (see examples on preceding page). Suppliers instituted similar programs with their venders. Even nonsuppliers got into the act. One came to Republic with an idea for replacing a $25-a-pound material with one selling for $1.50 a pound. Early tests indicate the lower priced material is the better one for this job.

One reason for the program's success: It was sold to venders as a business building technique, not one with the objective to beat down prices. "We have tried throughout to keep 'squeezing,' 'gouging,' and 'finger pointing' tactics out of it entirely," says E. I. Little, director of material. Another reason: It has helped increase vender sales, not only to Republic but to other customers. A third reason: Major concentration has been put on the 461 parts that account for 91 per cent of Republic's purchasing dollar, the area where major savings can be made.

● **Proof**—The goal for fiscal 1962 is to hit a 40 per cent reduction in the cost of equipment and subcontracts. The new target represents a 50 per cent increase over the $34 million in off-site savings already achieved. Even greater savings are probably ahead.

• An extra copy of this article is available until supply is exhausted. Write Editorial Service, STEEL, Penton Bldg., Cleveland 13, Ohio.



A cost-awareness chart for supervisors and workers is kept for each major job within a department. It gives a quick, visual comparison of where work stands in relation to the target

Reason for Taxation Often Lost

"THERE HAS grown up a tax structure so encrusted with tradition that, in some cases, we are missing even the point of taxation," Hickman Price Jr., assistant secretary of commerce, told the American Machine Tool Distributors' Association in Pittsburgh.

Speaking on the dire need for tax reform, he added: "We must find ways to provide an incentive for industry to replace obsolete machines."

Mr. Price warned that modernization of industrial facilities is essential, explaining that U. S. industry's ability to compete successfully in the highly competitive world market will be a vital part of our country's fight for survival.

Mr. Price said the full sting of foreign competition has not yet been felt by U. S. producers. "So far, we have only been tested by our friends and our allies. Even so, we have often been found wanting—to our sorrow." He added that we must be strongly competitive or we'll be unable to live alongside our adversaries.

• **An Essential Incentive**—Government must help industry in its battle for world markets, and tax reform would be a big assist, Mr. Price said. He told the machine tool salesmen that 80 per cent of the machine tools in use in the Common Market nations have been built since 1952. The same can be said for Japan. "In the U. S., 83 per cent of our machine tools were built before 1946."

A new tax proposal is forthcoming, Mr. Price promised. He wants to provide a true incentive for replacement, and he admitted that the administration's last proposal was a less-than-ideal compromise.

How should industry spend its amortization dollars?

Mr. Price emphasized the need for further U. S. automation to offset wage disadvantages.

"We can no longer assume that because a job has required five people, it will always require five people. We must automate, even in the face of some job losses in specific areas. By automating and modernizing, over the long period we will create a larger work force than we will by clinging to outmoded traditions."

Consultant cautions . . .

Reds Are Becoming More Design Conscious

IRON CURTAIN countries are stepping up their economic warfare through intensified product design efforts, warns Peter Muller-Munk, managing partner of Peter Muller-Munk Associates, Pittsburgh. Just returned from an international conference of industrial designers in Venice, he makes these observations:

1. In the past, the Russians have confused sheer bulk of machinery with performance. Their machine tools have been dependable but unsophisticated. Result: Poor sales in spite of low prices.

2. Soviet dominated nations now realize that their products must be better designed if they are to compete successfully in the world market.

3. They are still copying ideas that we discarded five years ago, but it would be dangerous to assume that they can't catch up.

4. Since Europe can provide its own needs, the main thrusts of Soviet economic penetration can be expected in India, Africa, and South America—not in the Common Market.

5. U. S. firms that are competing most successfully in Europe are setting up manufacturing facilities there and using European designers for maximum sales impact.

6. If U. S. firms want to export, they must provide adequate service abroad. Complaints in Europe about poor service on U. S. machinery are ominous.

Reynolds Makes Juice Cans

The aluminum industry continues to make the can market a primary target. Latest move: Reynolds Metals Co. will produce aluminum cans for frozen citrus juice manufacture and sell them directly to packers. Plans call for three assembly lines with a combined monthly capacity of 30 million cans to be in operation by mid-December, when the Florida juice packing season starts. For more than a year, Reynolds has been supplying can stock to major packers like Bird's Eye and Minute Maid, companies that fabricate their own containers.

This latest move, says Reynolds, "supplements our in-plant can assembly program by providing a realistically priced source of supply for the small packer who prefers to purchase finished cans rather than assemble them himself."

Exports to Reds Slated for Probes

Requests for Licenses Decline

(In millions of dollars)

	Red Satellites	USSR	Poland	Total*
1960				
1st quarter	$ 7.7	$27.5	$0.2	$35.4
2nd quarter	10.4	13.4	0.7	24.5
3rd quarter	12.2	7.2	0.2	19.5
4th quarter	6.7	8.7	0.3	15.6
1961				
1st quarter	15.6	7.6	0.7	23.8
2nd quarter	4.6	8.3	..	12.9
3rd quarter	9.0	2.6	1.5	13.2

*Data may not add up to totals because of rounding.

N.A. = Not available.

NOT ONE, but two, Congressional committees are preparing to investigate our trade relations with the Communist Bloc. On Oct. 23 or 24, the House Select Committee on Export Trade Control will meet in secret session to plan its approach to the problem of sending strategic goods to the Communists. Under the chairmanship of Rep. A. Paul Kitchin (D., N. C.), the committee is expected to hold public hearings, probably before Congress reconvenes in January. A staff director with 24 years' experience with the Federal Bureau of Investigation has been hired by the committee to run the investigation.

On the Senate side, the Internal Security Subcommittee, chairmanned by Sen. James O. Eastland (D., Miss.), with Sen. Thomas J. Dodd (D., Conn.) as vice chairman, also plans a study. Senator Dodd has repeatedly expressed concern that administration of the Export Control Act (which requires that licenses be granted for certain exports) has not been tough enough. He sees the Communists getting many products from us which can be classified as strategic defense items, even though they are not bombs or tanks.

● **HODGES TRIES TO CALM CONGRESS**—Last week Commerce Secretary Luther Hodges released preliminary data on third quarter licenses to export to the Reds (see table). The move (the full quarterly report won't be ready until the middle of November) was probably designed to calm Congressional fears that our exports to the Reds have been rising under the Kennedy administration. Newspaper stories have emphasized the short term increase in license approvals.

Secretary Hodges invited the House committee to view the export control operation. Members spent half an hour with one license processor at the Commerce Department to see what he looked for in deciding the strategic impact of a product exported to the Reds.

There has been a sharp decline in the value of goods licensed for export to the Soviet Bloc, Secretary Hodges reports. Since 1957, licenses for shipments to the USSR and Eastern Europe have averaged $20.5 million per quarter. The figure was $23 million for 1961's first quarter; it fell to $13 million in the second quarter and $12 million in the third period. Only $1 million worth of approvals were granted in September. License approvals don't necessarily mean exports.

However, exports to the Red Bloc may run higher than licenses approved because many consumer items do not require the special license. Of interest is the amount of exporting to the Communists done by other members of the Free World: In the first half of the year, West Germany shipped $370 million worth compared with our $100 million. Britain shipped $212 million worth of goods to the Reds, excluding Red China.

Textiles Get Depreciation Relief

The textile industry has won its case for a cut in equipment lives for depreciation purposes. Treasury Department announced last week that Bulletin F lives (for depreciation) are cut from 25 to 15 years and in some cases 12 years. Look for the railroad industry to get relief next.

Until the over-all depreciation study of the department is completed in December, don't look for any further announcement from the administration on its depreciation plans for next year. Chances are that the President will hold to the investment incentive program offered to Congress this year, with the provision that any revenue loss from a tax credit for investment in new equipment must be offset with revenue gain from other sources. As tentatively approved this year by the tax writing House Ways & Means Committee, the incentive would have amounted to 8 per cent and cost the Treasury only about $300 million in lost revenue if other offsetting tax proposals had been granted by Congress.

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Accurate 5° taper end mill is quickly ground on a CINCINNATI No. 1 Cutter and Tool Grinder.

Photo Courtesy of Conical Tool Company, Grand Rapids, Michigan

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Six Cutter and Tool Grinders are built by CINCINNATI to give you the right size and type for your cutters.

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NO. 2	CONTOUR	ELECTROLYTIC

All are constructed to the highest standards of performance and reliability. For example, table slideways of the Nos. 1 and 2 Machines are anti-friction; hardened and ground. Eccentric swivel mounting of wheelhead simplifies the setup chore of adjusting the wheel to the desired angle for grinding. In addition, it provides the effect of extra cross range when needed. Many other feature-advantages are fully described in attractive literature which we will gladly forward to you. Write or telephone today.

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MILLING MACHINE DIVISION

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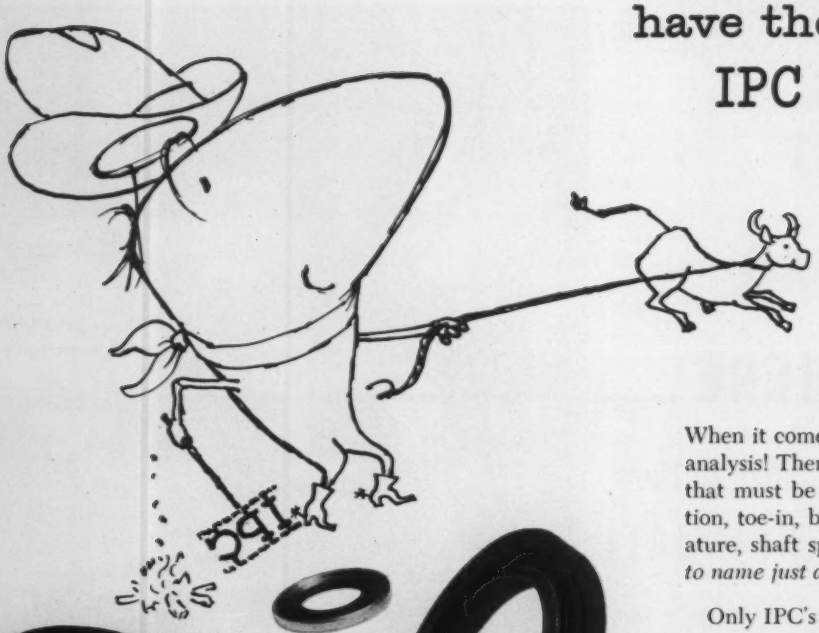

When it comes to leather . . . ask for analysis! There are so many variables that must be answered; torque, friction, toe-in, break-in period, temperature, shaft speed, impregnation . . . *to name just a few.*

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PRECISION MOLDING *Custom designed for your application*

INTERNATIONAL PACKINGS CORPORATION

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P3

1—BELGIUM, appeared July 10, p. 47
2—JAPAN, appeared Oct. 2, p. 30

WEST GERMANY

German Consulate

The Ten Largest German Industries - 1960

	Sales (Billions)	Number of Plants
Food	$7.5	6,392
Machinery	6.1	4,229
Chemical	5.6	1,945
Electrical	4.8	2,241
Iron & Steel	4.6	146
Textiles	4.1	4,301
Mining	2.6	644
Metal Fabricating	2.5	3,471
Stone & Earth	1.8	5,171
Apparel	1.7	4,094

Source: German Statistical Office.
Firms in West Berlin and the Saar are not included in this tabulation. So the large concentration of electrical and pharmaceutical plants in West Berlin is not reflected in the above figures.

U. S. MANUFACTURERS shipped more than $1 billion worth of goods into West Germany last year, and odds favor expanded trade in the future. The reason is *wirtschaftswunder*, the postwar "economic miracle" wrought by West German industry.

The Federal Republic's gross national product (GNP) has nearly tripled since 1950, soaring to $68 billion last year. The annual gross income of the nation's average jobholder jumped from $850 in 1950 to about $1700 last year. The real gross domestic product per jobholder rose by 6.1 per cent in 1960.

West Germany has turned the common problem of finding jobs for workers into the enviable problem of finding workers for jobs. The nation now has five job openings for every unemployed person. Only about 0.6 per cent of the nation's labor force is unemployed. And about 500,000 foreign workers have been imported for jobs.

• **What Germans Want**—"The interest of German importers in many U. S. lines is outrunning the in-

terest of U. S. manufacturers in supplying them." That summary by a U. S. Trade Mission to Germany this summer indicates the untapped potential in the West German market. The mission reported that Germany, with its high level of industrial activity, its severe labor shortages, its expanding exports, and higher standard of living, can continue to absorb large and increasing imports from the U. S.

The mission reports there is a "large market" for U. S. machine tools, steel, construction equipment, measuring and testing equipment, automatic recording and quality control equipment, material handling equipment, small office machines, automatic form handling equipment, vending machines, dishwashers, mixers, hardware, auto servicing equipment, and hundreds of other items.

The nature of Germany's imports is changing. While the nation's imports from all countries rose 19 per cent in 1960 vs. 1959, imports of finished goods increased 25 per cent and accounted for 32 per cent of total imports (vs. an average of about 19 per cent during the 1954-58 period). Agricultural products accounted for only 26 per cent of German imports last year (vs. an average of about 32 per cent during the 1955-59 period). It means that Germany is becoming an even more important market for U. S. producers of capital equipment, consumer durable goods, and some types of materials.

• **Private Consumption**—Saving is a traditional German trait, and the German people continue to patronize the nation's 865 mutual savings banks, but there is a growing tendency for the average German to spend more and save less. Last year, for example, spending by private households increased 9.7 per cent, while household income rose 9.4 per cent. Installment buying is increasing and now accounts for about 13 per cent of retail sales.

• **Industrial Production**—West Germany's index of industrial production (1950 = 100) averaged 249 in 1960 and reached 273 at mid-1961.

• **Steel**—The world's third largest steel producer (after the U. S. and Russia), Germany turned out 36 million ingots in 1960—4 million more than it did in 1959. And output may rise another 3 per cent or so this year. The German steel industry is expanding rapidly. Investments last year totaled about $300 million. And the annual investment figure for the next three years is expected to exceed $750 million. August Thyssen-Huette A. G., the biggest steelmaker in the European Coal & Steel Community, is beginning an expansion and modernization program that'll cost $162.5 million.

• **Machinery**—Output of German machinery makers last year totaled $6.1 billion—up 17 per cent from the 1959 figure. About 40 per cent of production is exported. Order backlogs, in many cases, stretch out 18 months or more.

• **Motor Vehicles**—Germany has become the world's No. 2 producer of automobiles, after the U. S. The nation turned out more than 2 million motor vehicles in 1960 (including 1,674,000 cars and 230,000 trucks). A record will probably be reached this year. June, 1961, production, for example, was 14.6 per cent above that of the like 1960 month. Nearly half the output is exported. Volkswagen production reached 890,000 units last year, and the firm expects to top the million mark in 1961. Ford Motor Co.'s German subsidiary, Ford Werke A. G., boosted production by 40 per cent last year to 214,000 vehicles.

• **Electrical Equipment**—German producers of electrical equipment sold $4.8 billion worth of their products last year—up 15 per cent from the 1959 level.

• **Homebuilding**—Nearly 5 million housing units have been built in Germany during the last decade, and annual completions are running around 600,000 units. The housing shortage is still serious, but the German Housing Ministry expects supply to catch demand by 1963.

• **Plastics**—Germany is second only to the U. S. in plastics output. Production approached 1 million tons last year—25 per cent above the 1959 figure.

• **Chemicals**—Germany has become the world's fourth largest producer of chemicals, with sales reaching $5.6 billion in 1960. The production index (1938 = 100) rose 14.7 per cent in 1960 to 312.

Blohm & Voss shipyard (foreground) and Schlieker shipyard (background) in Hamburg. About one-third of the German shipbuilding industry is located in Hamburg, where the industry is the largest employer

• **Natural Gas**—Natural gas output in Germany, up 15 per cent in 1960 (to 450 million cubic yards), is expected to reach 750 million cubic yards annually with the completion of planned pipelines.

• **Appliances**—Appliance sales in Germany set records annually. About 1 out of 4 German households has a TV set. The German-American Chamber of Commerce reports that more than 3 out of 5 households are expected to have sets by 1966. Last year, 2,169,000 sets were produced in the Federal Republic. Washing machine production has increased phenomenally. In 1950, only 13,000 washing machines and no dryers were produced. In 1960, 900,000 washing machines and 1 million dryers were turned out. And German imports of laundry equipment are high. Germany imported more than $4 million worth of washing machines in 1960, about $250,000 worth from the U. S. The West German refrigeration industry has climbed to the number two spot in production, following only the U. S. In 1960, 2.2 million refrigerators and freezers were produced. Raymond P. Ludden, U. S. consul general, says the outlook for U. S. exports of appliances to West Germany "seems very promising." He particularly cites electric water heaters, washing machines, dishwashers, refrigerators, freezers, and air conditioners.

• **U. S. Investment**—In 1959, the U. S. Chamber of Commerce in West Berlin reported that there were about 350, wholly owned U. S. firms operating in West Germany, including West Berlin. The

Quick Facts On West Germany

POPULATION—About 53.5 million, plus 2.2 million in West Berlin. Refugees from the East account for about one-fourth the Federal Republic's population.

AREA—95,913 square miles, including West Berlin. It's about equal to New York and Pennsylvania combined.

CURRENCY—The Deutsche Mark (DM) has a par value with the International Monetary Fund of DM 4 equals U. S. $1. There are coins of 1, 2, 5, 10, 50, 100, 200, and 500 pfennigs (100 pfennigs equals 1 DM) and notes of 5, 10, 20, 50, and 100 DM.

RELIGION—About 51 per cent are Protestant; 44 per cent are Roman Catholic.

GOVERNMENT—It consists of a bicameral legislature, composed of a federal council (Bundesrat) and a federal diet (Bundestag). The chief of state is the president; the chief executive is the chancellor.

POLITICAL PARTIES—The four principal parties are the Christian Democratic Union (CDU), the Social Democratic party (SPD), the Free Democratic party (FDP), and German party (Deutsche Partei).

WEIGHTS AND MEASURES—West Germany uses the metric system.

PRINCIPAL CITIES—Hamburg (Population: 1.8 million), Munich (1.1 million), Cologne (790,000), Essen (730,000), Duesseldorf (700,000), Frankfurt (670,000), Dortmund (640,000), Stuttgart (640,000), Hanover (560,000), Bremen (520,000). Bonn, the provisional capital, has about 150,000 inhabitants.

WEST GERMAN TRADE WITH U. S.

(In millions of dollars)	1960	1959	1958	1957
U. S. exports to Germany	1,067	749	735	957
U. S. imports from Germany..	897	919	635	670

TRANSPORTATION—West Germany had 69 automobiles per 1000 inhabitants at the end of 1960. That compares with 334 per 1000 in the United States, 215 in Canada, 150 in the Netherlands, 99 in France and the United Kingdom, 33 in Italy.

What West Germany Buys from U.S.

(U. S. Exports to West Germany, 1960—Millions of Dollars)

Machine Tools	25.94
Metalcutting Types	20.17
Lathes & Screw Machines	3.29
Boring Machines	0.47
Tapping & Threading Machines	0.17
Milling Machines	0.29
Gearmaking Machines	4.17
Drilling Machines	0.10
Planers, Shapers & Slotters	0.08
Grinding Machines†	3.55
Sawing & Cut-off Machines	0.05
Polishing & Buffing Machines	0.13
Multi-Station Machines	3.80
Broaching Machines	0.68
Other Metalcutting Types & Parts	3.38
Metalforming Types	5.77
Presses	0.82
Bending & Rollforming Machines	0.24
Punching & Shearing Machines	0.28
Forging Machines	1.76
Parts & Accessories	2.67
Steel Mill Products	23.07
Bars	0.15
Tin Mill Products	1.15
Sheets & Strip	20.99
Pipe & Tubing	0.61
Other	0.17
Ferroalloys	1.90
Bearings	1.93
Motors & Controls	1.04
Material Handling Equipment	1.59
Ores, Concentrates, Scrap & Forms:	
Aluminum	42.89
Copper	83.85
Lead	0.02
Nickel	3.50
Tin	0.03
Zinc	1.17
Other Nonferrous	14.18
Packaging Machinery	0.82
Office Machines	21.90
Motor Vehicles & Parts	5.91
Watercraft & Parts	1.37
Aircraft & Parts	30.91*

†Includes honing and lapping machines.
*Based on incomplete U. S. data.

establishment of the Common Market has attracted many U. S. corporations to German soil—via subsidiaries, or co-operative ventures. German industrialists are particularly interested in the exchange of technical knowhow and continually seek to manufacture new U. S. products under licensing arrangements.

• **Advertising**—Outlays for advertising in West Germany have reached nearly $500 million annually. Around 19 million copies of newspapers are printed daily in the nation. There are also about 5000 mass magazines and about 3500 specialized business and technical publications.

• **Division**—Germany has two sectors that parallel in many ways the North and South in the U. S. Northern Germany is "down to the point," while southern Germany is "more talkative, homey, and folksy," reports a U. S. banker who visits German businessmen regularly.

• **Buying Influences**—Purchasing of industrial equipment in Germany is also similar to the U. S. method. Buying capital equipment is a team effort. However, generally, the team is composed of top level people. In many German firms, though, the top research executive is an important member of the buying team. In fact, the top research man often sits on the company's board of directors.

• **Management**—Many U. S. visitors to Germany are impressed by three factors in industrial management: 1. Top managers seem to work harder than their U. S. counterparts. 2. The management structure has less depth than it has here. 3. German industry is frantically training young executives.

• **Information**—Many large German firms operate their own "clipping services." Technicians cut out magazine articles and route them to the proper executives.

• **Top Opportunity**—U. S. makers of automated equipment are finding an excellent market in Germany. The republic's labor shortage and its mounting wage pressures have forced the German executive into a position far too familiar to his U. S. counterpart. Both must concentrate on finding ways to pare labor costs. The answer in Germany has increasingly become investment in modern machinery. Result: U. S. producers of items such as numerically controlled machine tools and conveyors can find receptive ears.

• **For Assistance**—The U. S. firm interested in exporting to West Germany can find considerable assistance. Here is a partial list of information sources:

• *Machinery Importers and Dealers—Federal Republic of Germany and West Berlin*, published by the Bureau of Foreign Commerce, U. S. Department of Commerce, gives the names, addresses, and descriptive information on more than 300 machinery importers and dealers. An index keys 37 categories of machinery to the list.

• *Rundt's Market Report No.* 307, issued Apr. 5, 1961, by S. J. Rundt & Associates, New York, is a comprehensive, 55 page summary of the German economy. (Mr. Rundt is a consultant to STEEL INTERNATIONAL.)

• The German-American Chamber of Commerce, New York, publishes a monthly magazine, *German American Trade News*, and a weekly newsletter, *German Business Weekly*. Both carry information of value to the U. S. exporter.

• Among books of interest to the U. S. exporter: *Modern German History* (New York; Dutton; 1959), *History of Modern Germany* (New York; Knopf; 1959), *Watcher on the Rhine: An Appraisal of Germany Today* (New York; Morrow; 1957), *Germany: A General and Regional Geography* (New York; Dutton; 1953).

** An extra copy of this article (and others in this series) is available until supply is exhausted. Write Editorial Service, STEEL, Penton Bldg., Cleveland 13, Ohio.*

EF

Roller Hearth Furnaces

for bright and scale-free annealing copper and copper alloy, wire, rods, bars, tubing and other non-ferrous and ferrous products.

The EF direct gas fired, forced circulation, roller hearth annealing furnace pictured below anneals 10,000 lbs. of ⅜″ to 6″ O.D. copper or copper alloy tubing per hour; lengths up to 36 feet, temperatures from 275°C. to 850°C.

Non-ferrous and ferrous wire, rods and bars are also frequently heat treated in furnaces of this type. When closer atmosphere control is needed, EF roller hearth furnaces of generally similar design are furnished either electrically heated or radiant tube fuel fired. EF specially designed run-out tables simplify inspection, sorting, boxing or strapping for shipment.

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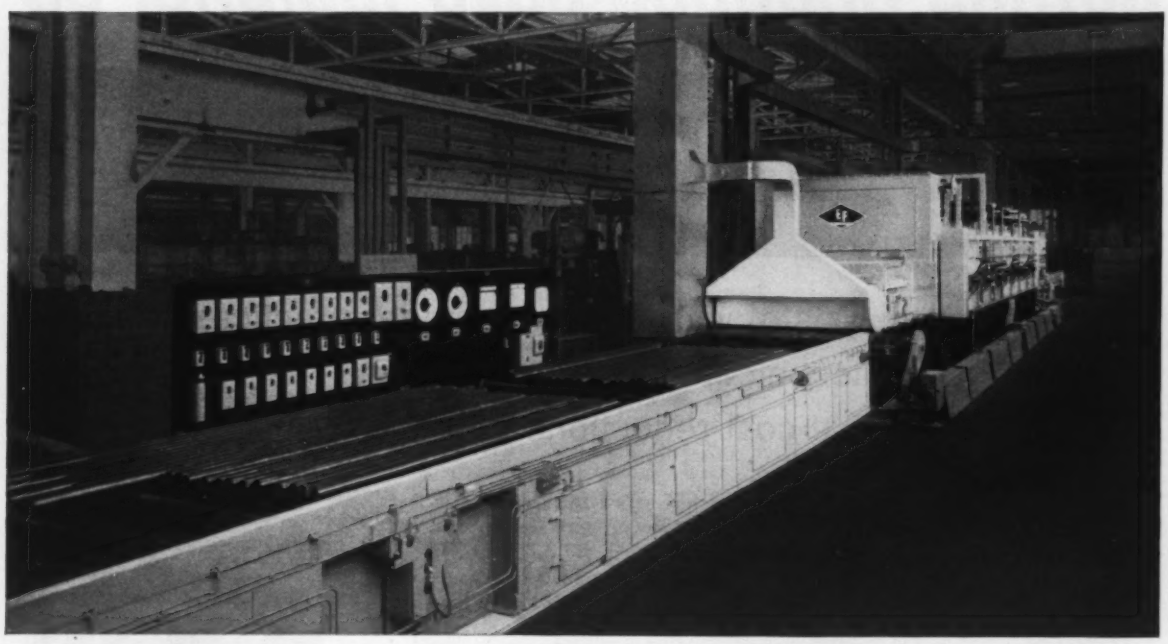

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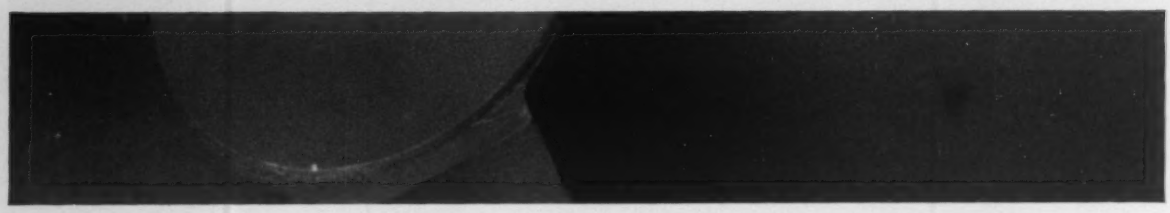
SALES REPRESENTATIVES—2842 West Grand Blvd., Detroit 2, Mich. • also 968 Coleman Rd., Cheshire, Conn.

Simple changes save fastener $$



Value analysis of your current fastener practices by RB&W technical advisors can result in substantial cost reductions

Here are typical savings made possible through recommendations by RB&W fastener specialists...made after carefully analyzing product design and assembly upon request.

Manufactured product	Cost Reductions Made Possible
Automatic machine assemblies	$97,000 per year
Cooler-and-condenser units	$16,500 per year
Refrigeration units	$ 7,800 per year
Compressors	$12,000 per year

The striking thing about all these cost reductions is that they required merely a substitution to be realized ...a standard high strength bolt rather than a special alloy fastener ...a hex screw in place of a socket screw. No product design changes were involved.

How about a survey of your own fastening operations? Wherever fasteners are used in quantity, there are bound to be areas where you can shave costs simply by having assembly specifications altered. An RB&W fastener specialist, working with your engineers, can locate them for you. He's no smarter than your own people, but knows his specialty best and also what to look for. Write Russell, Burdsall & Ward Bolt and Nut Company, Port Chester, N. Y.

R B & W

117th year

Plants at: Port Chester, N. Y.; Coraopolis, Pa.; Rock Falls, Ill.; Los Angeles, Calif. **Sales office and warehouse at:** San Francisco, Calif. **Additional sales offices at:** Ardmore (Phila.), Pa.; Pittsburgh; Detroit; Chicago; Dallas.

This Thunderbird console section (where the young lady is resting her left hand) is produced from vinyl clad steel. Auto designers are finding more and more uses of vinyl coated steel in such areas as center pillars, kick panels, glove box doors, rear package ledges, and inner tailgates on station wagons. It's the big reason why . . .

Ford Does Its Own Vinyl Coating

PRODUCTION of vinyl laminated sheet steel has started at Ford Motor Co.'s chemical products plant, Mt. Clemens, Mich. The clad steel is shipped to venders and company manufacturing plants where it's stamped into interior parts for Ford's cars. John F. Frailey, plant manager, says the Mt. Clemens line has a daily shift capacity of 3400 sq ft. It will supply about one-third of Ford's requirements for 1962 cars.

Ford's process differs from that used by U. S. Steel Corp., which runs coils of steel through a liquid vinyl bath.

• **Prime User**—Ford is the only automaker to make extensive use of the vinyl coated steels, although several carbuilders have bonded vinyl sheets to finished and assembled parts. Best current example: The vinyl "fabric" top on Buick's Skylark.

General Motors Corp. does not use the laminating technique. It sprays the material on parts. But its Fisher Body Div. will not discuss the method which is used to coat trunk interiors and other parts. GM refuses to comment on industry reports that it will turn to vinyl laminated steels in 1963. Suppliers say that even though spraying is theoretically less expensive, final costs are about equal because the resin used for plastisol spray materials costs about 27 cents a pound, compared with 16 to 17 cents for film type vinyl powder. Vinyl clad steel for automotive uses sells for 35 to 38 cents a sq ft.

• **Interior Use** — Ford's first vinyl coated steel application was the 1956 Mercury center pillar. It then tried the material for the package tray and console panel on 1958 Thunderbirds. Those uses have spread to the other car lines. A major application is the interior tailgate panel for station wagons, says Donald Jones, supervisor, body engineering materials laboratory. Mr. Jones suggests future applications may include garnish moldings, side seat shields, instrument panels, and rear package trays.

Vinyl's biggest advantages are corrosion protection, plus a broad range of colors, grains, and textures for styling purposes. Laminating also permits short production runs. Although Ford does not have exact consumption figures, it's estimated that 495 tons of vinyl coated steel were used in 1956 cars. This has risen to some 2500 tons for 1961 models. It should exceed 3000 tons next year.

• **Problem Areas** — Although Ford originally experimented with spray coatings, it found that the scuff resistance of the product wasn't satisfactory. The biggest problems in using the vinyl laminates come in processing, forming, and assembly, reports Robert Saxon, manager, advanced body development unit. Vinyl is difficult to weld because it's dielectric. Health

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and safety factors must be considered because of possible toxicity during welding. Deep drawing requires careful attention because the vinyl can crack or pull away from the steel. Special separators and packaging materials are needed to protect finished parts during shipping to assembly plants.

Ford's specifications cover drawing, adhesion, shrinkage, humidity, staining, fading, aging, and cracking properties—the last five are relatively easy to meet. On drawing, the specs say the laminate must be capable of being bent 180 degrees around a ½ in. mandrel without damage to the vinyl or the bond. Adhesion must withstand a minimum of 15 lb of tension. The vinyl must show no shrinkage after seven days at 190° F.

• **Outlook**—Ford's interest in vinyl does not stop with automotive applications. Mr. Frailey claims that the Mt. Clemens plant is the only facility in the country that's integrated so it can make the vinyl, then laminate it to metals. It can produce 38,000 yd of vinyl per shift. Steel is only one of several materials being coated, including some nonmetals. Ford plans to be selling the vinyl and vinyl laminates in 27 nonautomotive markets by the end of 1962. It will be marketed through the company's Autolite Div.

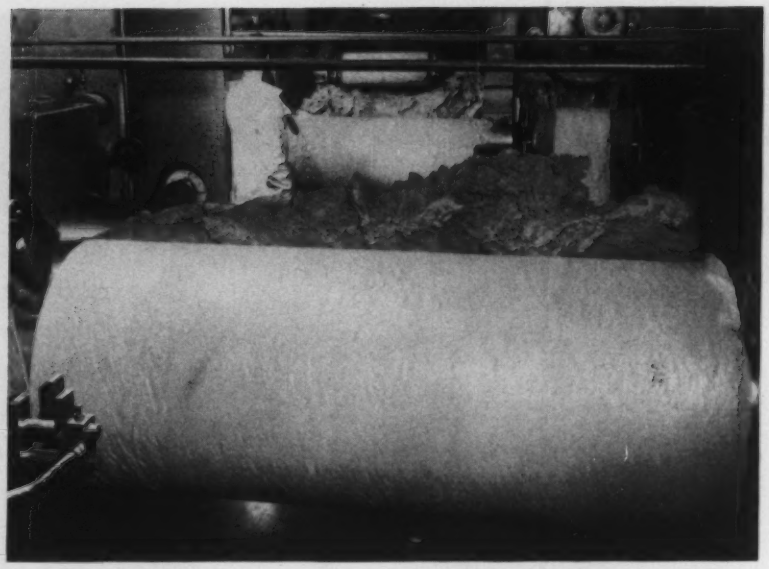
U. S. Auto Output

Passenger Only

	1961	1960
January	415,857	688,690
February	364,385	659,298
March	407,959	654,241
April	446,739	582,869
May	542,303	611,260
June	599,474	613,136
July	399,191	434,377
August	195,266	305,514
September	354,491	407,691
9 Mo. Totals	3,725,665	4,957,076
October		617,972
November		597,638
December		523,422
Total		6,696,108

Week Ended	1961	1960
Sept. 9	83,421	52,635
Sept. 16	64,164	85,879
Sept. 23	73,034	120,722
Sept. 30	114,551	134,118
Oct. 7	103,449†	140,832
Oct. 14	105,000*	144,056

Source: *Ward's Automotive Reports.* †Preliminary. *Estimated by STEEL.



Vinyl paste is kneaded at 350° F prior to calendering operation that produces vinyl film of proper thickness

How Ford Makes Vinyl Laminated Steel

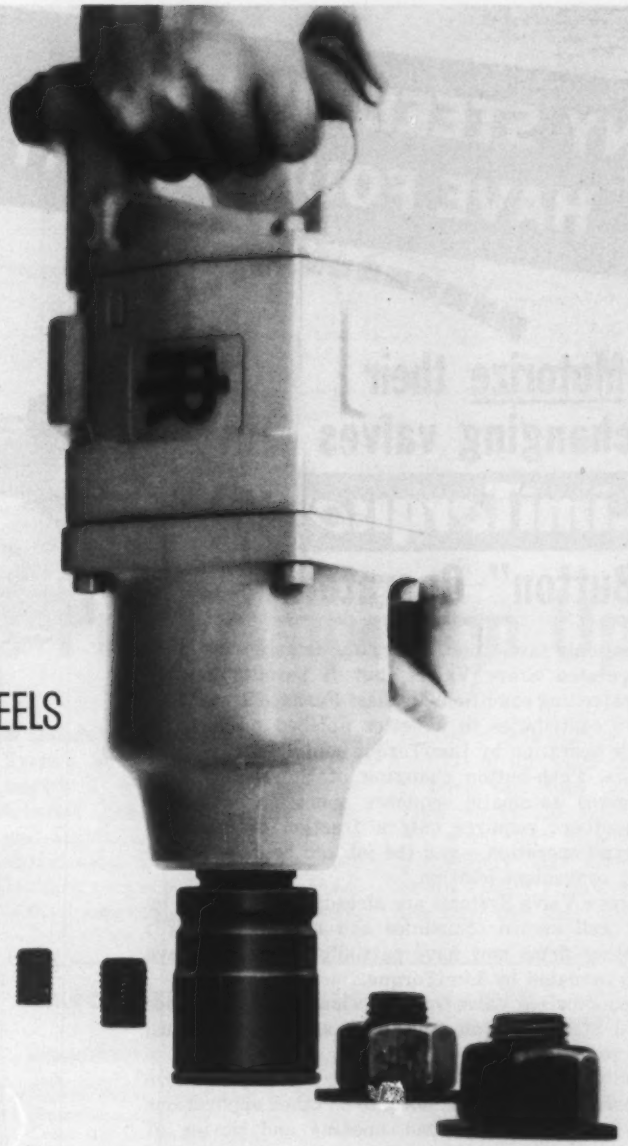
VENDERS store vinyl powder outside Ford's Mt. Clemens plant in 100,000 lb, railroad hopper cars. When it's needed, the vinyl powder is sucked into large mixing tanks through an air hose. Coloring agents and plasticizers are added. The aggregate is worked in Banbury mixers at 350° F until it becomes a paste. A pound of paste makes about 1 yd of vinyl.

The hot paste is pushed through a three high calendering mill—it's similar to a steel rolling mill in operation. Hot water is piped through the 28,000 lb calendering rolls at 200 psi to heat them to 300-350° F. Each roll is temperature controlled. Roll movement can be controlled within 0.0070 in. per minute. The bottom work roll is contour ground to compensate for thickness in the vinyl. Hydraulic roll benders help control vinyl gage to within 0.0002 in. Thickness is checked by a radioisotope gage. As it comes out of the calendering mill, the vinyl sheet is spun into rolls up to 40 in. OD.

After calendering, the vinyl film is given a pattern by running it through one to four print rolls. It's coated with a clear (Lucite type) soil resistance material and passed through an embossing roll to give it texture. It's then unrolled, inspected, and rerolled ready for laminating.

Meanwhile, cold rolled sheet steel up to 52 in. wide and 0.035 in. thick is being run through a continuous phosphating and Bonderizing line. It passes on through an electric drying oven at 200 to 250° F. The steel is removed from the line and reinserted through the oven. On its second trip, it passes through two roll coaters. The first applies a corrosion resistant paint primer to the back of the sheet. The second roll coater applies a metered amount of epoxy adhesive which is heat activated at 400 to 425° F.

As the primed steel leaves the oven, the vinyl film which has been threaded through a series of rollers, is laminated to the metal between rolls. The vinyl coated sheets are quenched in water spray, and excess water is squeezed off between rubber rolls. Remaining moisture is blown off by air jets. The steel is manually loaded on the laminating line so operators can inspect it for pinholes, occlusions, and other surface defects.



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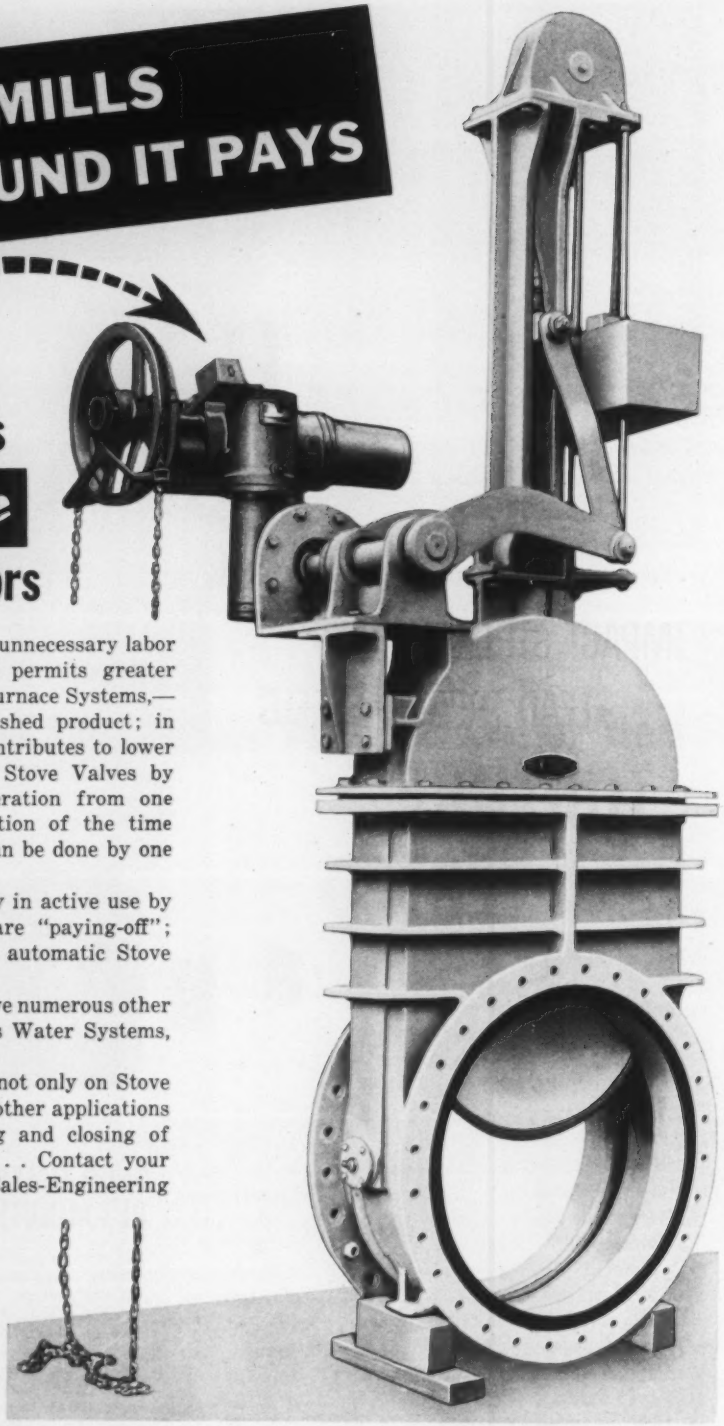

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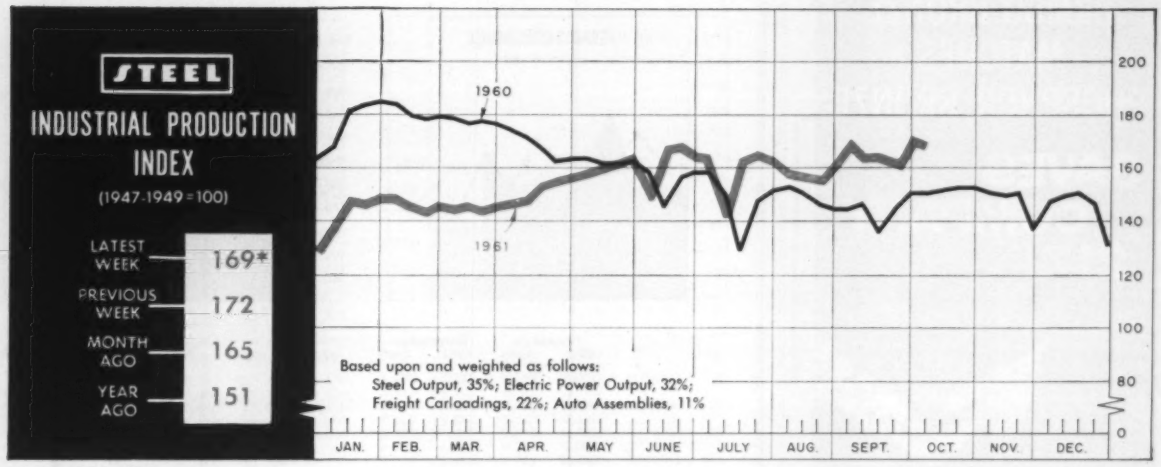


*Week ended Oct. 7.

Auto Strikes Put Damper on Upturn

LOOK for the erratic behavior of STEEL's industrial production trend line above to continue through most of October, followed in November and December by a steady movement to record levels.

LOOK FURTHER for the Federal Reserve Board's industrial production index to stand still in September and show little improvement in October, followed by a significant upturn in November and December.

• **Reason**—The auto industry is causing the unusual zigzag pattern evident in the above trend line since early September. Until all labor pacts have been settled in the industry, that pattern will prevail. But that is not likely to happen until late October or early next month.

The effects of automotive unrest cannot be measured alone by what it does to the number of cars and trucks turned out in any given week. If that were the case, the net effect would be difficult to find on such a broad indicator as the FRB index, where the automotive sector accounts for only 5.04 per cent of the total. But when you consider the impact on steelmaking (6.21 per cent of the total) and fabricated metal products (5.42 per cent), it takes more strength elsewhere than is available now to overcome a major work stoppage in motordom.

• **Schedule**—On an index such as STEEL's, with a narrower base, the impact is evident. The strike at General Motors Corp. caused the mid-September slump. When it was settled—and the entire industry was building cars at a fairly normal rate—the index responded immediately, setting a 1961 high of 172 (1947-49 = 100) in the week ended Sept. 30.

Then the Auto Workers struck Ford Motor Co., and immediately the trend line dipped again to a preliminary 169 during the week ended Oct. 7. Ford produced during only two days that week. As

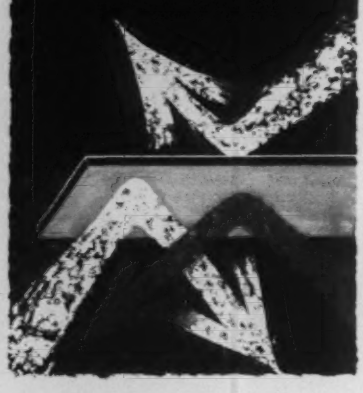
BAROMETERS OF BUSINESS

	LATEST PERIOD*	PRIOR WEEK	YEAR AGO
INDUSTRY			
Steel Ingot Production (1000 net tons)	2,080[1]	2,102	1,579
Electric Power Distributed (million kw-hr)	15,300[1]	15,340	14,107
Bituminous Coal Output (1000 tons)	8,770[1]	8,660	8,378
Crude Oil Production (daily avg—1000 bbl)	7,150[1]	7,156	6,803
Construction Volume (*ENR*—millions)	$450.5	$465.4	$602.8
Auto, Truck Output—U. S., Canada (*Ward's*)	128,491[1]	142,821	165,030
TRADE			
Freight Carloadings (1000 cars)	635[1]	639	646
Intercity Truck Tonnage (changes from year ago)	+3.3%	+2.7%	−1.0%
Business Failures (Dun & Bradstreet)	286	337	304
Currency in Circulation (millions)[2]	$32,673	$32,612	$32,046
Dept. Store Sales (changes from year ago)[2]	+5%	+4%	+4%
FINANCE			
Bank Clearings (Dun & Bradstreet, millions)	$29,778	$29,144	$28,926
Federal Gross Debt (billions)	$293.7	$291.8	$288.1
Bond Volume, NYSE (millions)	$27.4	$30 2	$22.2
Stocks Sales, NYSE (thousands of shares)	16,241	16,556	12,208
Loans & Investments (billions, adjusted)[3]	$117.1	$115.9	$106.2
U. S. Govt. Obligations Held (billions)[3]	$34.5	$33.2	$27.8
PRICES			
STEEL's Finished Steel Price Index[4]	247.82	247.82	247.82
STEEL's Nonferrous Metal Price Index[5]	224.8	225.5	227.9
All Commodities[6]	118.7[1]	118.7	119.5
Commodities Other than Farm & Foods[6]	127.1[1]	127.1	128.1

*Dates on request. [1]Preliminary. [2]Federal Reserve Board. [3]Member Banks, Federal Reserve System. [4]1935-39=100. [5]1936-39=100. [6]Bureau of Labor Statistics Index, 1947-49=100.

BRMCO BRONZE MATCHES PHOSPHOR BRONZE

SAVES COMPANY 21%



Detch Electric Company cut material costs 21% by switching from phosphor bronze to BRMCO Bronze—and didn't sacrifice any necessary material characteristics. In fact, BRMCO Bronze ranked higher in uniformity, workability, and electrical conductivity. Its spring quality and corrosive resistance are excellent.

BRMCO Bronze, developed for the electrical and electronics industries, is suitable for most applications where phosphor bronze is used . . . *yet costs at least 15 cents a pound less!* Used mainly in the electrical field, it is also suitable for applications in other industries where its superior characteristics and lower cost are primary considerations.

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BRMCO

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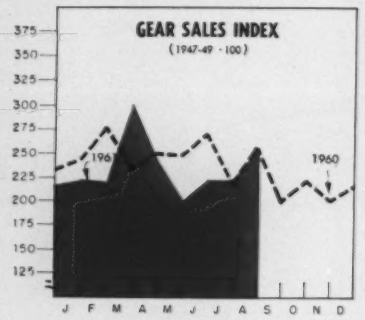
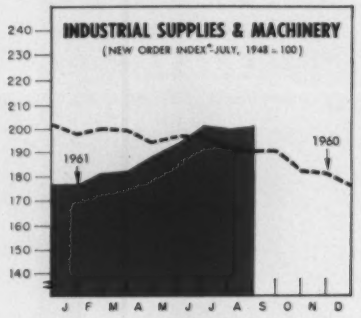
Subsidiary of ATCO CHEMICAL-INDUSTRIAL PRODUCTS, INC.

THE BUSINESS TREND





	Bookings 1961	Bookings 1960	Shipments 1961	Shipments 1960
Jan.	220.8	243.4	227.3	207.3
Feb.	218.3	278.6	214.4	230.2
Mar.	299.3	231.8	246.8	244.6
Apr.	241.9	249.2	233.9	234.8
May	198.0	246.9	239.1	241.3
June	220.0	269.8	245.4	253.6
July	219.8	217.5	200.1	210.8
Aug.	252.5	255.8	240.4	217.3
Sept.	....	197.9	....	223.5
Oct.	....	219.9	....	220.6
Nov.	....	198.9	....	226.7
Dec.	....	216.5	....	220.0
Avg	....	235.5	....	227.6

American Gear Mfrs. Assn.

	1961	1960	1959	1958
Jan.	176	198	186	163
Feb.	181	200	202	157
Mar.	182	199	221	149
Apr.	188	194	218	148
May	194	196	218	152
June	201	197	212	164
July	200	191	216	170
Aug.	201	190	212	172
Sept.	...	190	207	178
Oct.	...	182	204	187
Nov.	...	181	202	189
Dec.	...	176	202	190

*Seasonally adjusted.
Amer. Supply & Machinery Mfrs.' Assn.

Charts copyright, 1961, STEEL.

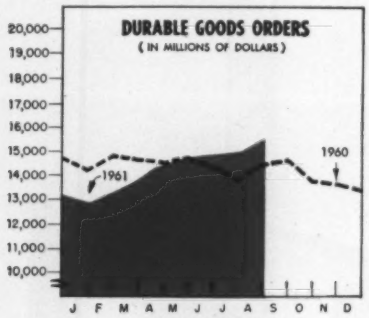
STEEL went to press, it looked like the settlement would come late last week, which probably precluded any significant production for the week ended Oct. 14. As a result, the trend line likely will show a further decline for that period.

• **What's Next?**—That leaves a week or so of automotive peace—with substantially full production—before trouble hits at Chrysler Corp. During that time, the production trend line will peak, as it did in late September. But if the Auto Workers strike at Chrysler, which many Detroiters expect, it will dip again. The Chrysler situation is expected to follow the GM pattern—national agreement with some locals striking because of local issues. (At Ford, the union called a nationwide strike against the company.) The effect, observers point out, will be the same—complete shutdown. The stoppages will probably last about ten days, as in the other two strikes, with production returning to normal in early November.

But the dip probably won't be as great as in the two previous cases. Chrysler is the smallest of the Big Three—it produced only 19,186 cars in the latest week compared with 63,306 units at GM. And its effects on labor will not be as broad, since most of the corporation's facilities are in the Detroit area.

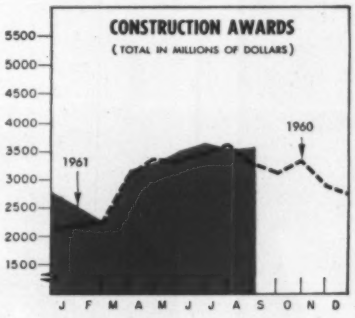
• **What About AMC, S-P?**—Once the Chrysler pact is signed, there should be no more major automotive labor disputes for a while. The failure of the Kenosha, Wis., local of American Motors Corp. to ratify the profit sharing plan last week should not result in a strike, say automotive observers. In the first place, the union has not authorized a strike at AMC. Even if the local—which has a reputation as a troublemaker—should take a strike vote, it is doubtful that the national union would approve it. In addition, pressure will be applied to the Kenosha local to settle because AMC's other locals have. While some minor wildcat strikes could occur, they would not affect total Rambler output too much.

Over in South Bend, Ind., the deadline at Studebaker-Packard Corp. is Nov. 30. But nobody expects any serious problems there because the company is a special case in the automotive industry. Besides, a rather definite pattern will have been set by that time. Even if S-P workers decided to walk out,



	New Orders*		Sales*	
	1961	1960	1961	1960
Jan.	$12,880	$14,190	$13,170	$15,450
Feb.	13,360	14,800	13,320	15,670
Mar.	13,820	14,640	13,690	15,170
Apr.	14,380	14,470	14,150	15,000
May	14,800	14,680	14,580	15,060
June	14,920	14,340	14,690	14,880
July	15,030	13,840	14,790	14,730
Aug.	15,560†	14,410	15,190†	14,420
Sept.	.....	14,620	.....	14,410
Oct.	.....	13,740	.....	14,080
Nov.	.....	13,600	.....	13,810
Dec.	.....	13,220	.....	13,620

*Seasonally adjusted. †Preliminary.
U. S. Office of Business Economics.



	Total		Building	
	1961	1960	1961	1960
Jan.	2,485	2,193	1,787	1,728
Feb.	2,235	2,240	1,674	1,685
Mar.	3,166	3,046	2,398	2,361
Apr.	3,297	3,360	2,504	2,527
May	3,501	3,337	2,658	2,563
June	3,602	3,472	2,779	2,593
July	3,529	3,597	2,656	2,481
Aug.	3,543	3,295	2,676	2,610
Sept.	....	3,119	....	2,402
Oct.	....	3,319	....	2,555
Nov.	....	2,886	....	2,169
Dec.	....	2,718	....	1,872
Totals	....	36,318*	....	27,345*

*Monthly figures do not add up to totals because of yearend revisions.
F. W. Dodge Corp.

it would mean a loss of only 2500 to 3000 units a week out of a total which should be near 150,000 by then.

• **Applying the Damper**—When the Federal Reserve Board announces its industrial production index reading for September later this week, it may seem that the recovery has run out of steam because of the automotive situation. In figuring the index, the Fed does not make allowances in its seasonal adjustments for strikes. In addition, some economists within the Federal Reserve System itself feel that adjustments are likely to be made in the latter part of the year to account for the early automotive model changeover, which was not noticeably reflected in the July figure. So the September level is expected to show only slight improvement—if any—over the August reading of 113 (1957 = 100). October may show a 1 point advance, whereas 2 or more points might have been expected if original auto production schedules had been achieved.

• **Forced Draft** — But November should evidence one of the biggest gains in the production indexes since the recovery began. Auto producers may well be pushing their assembly schedules to the highest peak since the closing months of 1955. Before the Ford walkout, they had slated fourth quarter output at 1,897,400 units, second only to the 1955 total. This included an attempt by GM to make up for about 70,000 of the 150,000 units it lost in September. Ford is expected to boost its November-December schedules, also, to make up some of its strike losses. If Chrysler is faced with the same problems, it could add to the strength in the final weeks of 1961.

In fact, most reports indicate the strength may carry well over into 1962, especially if sales in the last ten days of September are any indication of new model acceptance.

Consumer Perking Up

Renewed interest in car buying is only one of several signs that the consumer may at last be loosening his purse strings. Dun & Bradstreet Inc. reports for the second consecutive week that retail purchases are trending upward. In addition to new cars, appliances are continuing to move well. Department store sales continue to show gains over the year-ago period (see Barometers of Business, Page 95).

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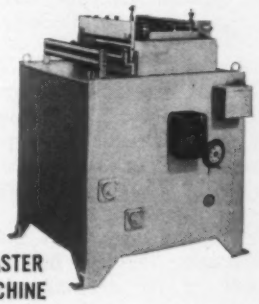

BENCHMASTER "FS" MACHINE

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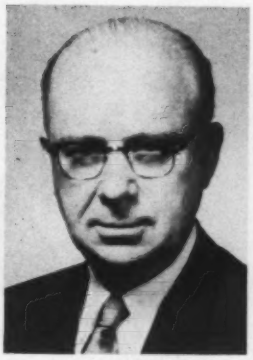
EDWARD S. BUNN
Revere Copper v. p.



J. A. STREET
Sheffield dir.-purchases

JOHN H. LAMB
GM procurement executive

SAM E. CUMPSTON
I-T-E div. eng. mgr.

Edward S. Bunn was elected vice president-research and development, **Revere Copper & Brass Inc.**, New York. He succeeds **Richard A. Wilkins**, retired. Mr. Bunn was general manager of the company's Research & Development Dept., with headquarters in Rome, N. Y.

M. E. Dowden was promoted to manager of scrap purchases, **Sheffield Div.**, Kansas City, Mo., Armco Steel Corp. He replaces **J. A. Street**, appointed director of purchases for the division. Changes result from retirement of **Harry L. Kenagy**.

Carl J. Demrick was made vice president-manufacturing for all divisions of **Avis Industrial Corp.**, Detroit.

M. C. Patterson was elected president and treasurer, **Saginaw Bearing Co.**, Detroit. Former vice president of Chrysler Corp. and general manager of its Dodge Div., he succeeds **William Agricola**, who retires in February.

John H. Lamb was named executive in charge of procurement, **General Motors Corp.**, Detroit, to succeed **Raymond H. Vogel**, who retires Nov. 1. **Nicholas J. Stock** replaces Mr. Lamb as manager of purchases at **Cadillac Motor Car Div. Edsel A. Illy** was made assistant manager-purchases at Cadillac, and **Harold R. Townsley** replaces Mr. Illy as senior product buyer.

John J. Brogan was named executive vice president, **Cleveland Pneumatic Industries Inc.**, Cleveland. He also assumes the title of general manager, Cleveland Pneumatic Tool Co., a division.

Howard C. Beyer was elected president of **Jeta Inc.**, Yonkers, N. Y., to succeed **Anthony Sperdini**, now chairman. Mr. Beyer was manager of the Power Equipment Div.

W. W. Leonard was made manager of tubular sales, **Colorado Fuel & Iron Corp.**, Denver. **D. W. Kelly** was made assistant to Mr. Leonard.

Sam E. Cumpston was appointed engineering manager, Special Products Div., **I-T-E Circuit Breaker Co.**, Philadelphia. He succeeds **F. J. Gardiner**.

Jack F. Hopper was made sales manager, **Electric Welding Co.**, Pittsburgh, subsidiary of Fort Pitt Bridge Works. He succeeds **George A. James**, retired.

Robert W. Grubbs was made assistant director of purchases for **National Tube Div.**, Pittsburgh, U. S. Steel Corp. He succeeds **Joseph F. Byrne**, transferred to Columbia-Geneva Div.

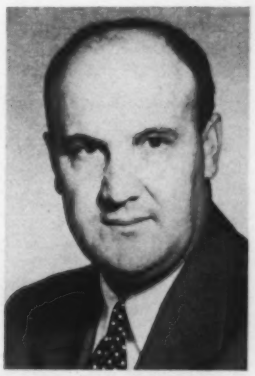
B. Nevling Clune was made vice president and general manager, Scale Div., Yonkers, N. Y., **Fairbanks, Morse & Co.**

Frank C. DiLuzio was named vice president-engineering for **Fairbanks, Morse & Co.'s** Beloit Group at Beloit, Wis. He was deputy manager of the Atomic Energy Com-

M. C. PATTERSON
Saginaw Bearing president

HOWARD C. BEYER
Jeta president

W. W. LEONARD
CF&I tubular sales mgr.



FRANK C. DiLUZIO
Fairbanks, Morse v. p.

A. W. CONNAR

WILLIAM H. JAMESON

Bethlehem Steel appointments

ARTHUR SUBSTAD

LLOYD JOHNSON

Despatch Oven vice presidents

mission's Albuquerque, N. Mex., operations office. He joined Fairbanks' Albuquerque Electronics Research Div. last January as general manager.

A. W. Connar, assistant to vice president-purchasing, was named general purchasing agent of **Bethlehem Steel Co.**, Bethlehem, Pa. **William H. Jameson** succeeds **Ethan F. Ball**, retired, as chief engineer, Fabricated Steel Construction Div.

T. A. Reeves, former general sales manager, Reeves Div., Dover, Ohio, **Empire-Reeves Steel Corp.**, Mansfield, Ohio, was made assistant vice president-sales for the company. **D. S. Bergert** succeeds Mr. Reeves.

Pennsalt Chemicals Corp., Metal Processing Dept., Philadelphia, named to new sales posts **Robert M. Burford** as supervisor-equipment sales; **Bernard C. Voltz**, supervisor-installation and inspection; **Oscar Maxstadt**, supervisor-design engineering.

Arnold Substad, general manager, was made a vice president of **Despatch Oven Co.**, Minneapolis. **Lloyd Johnson** was made vice president-manufacturing. He was works manager.

L. A. DePolis was elected president of **FWD Corp.**, Clintonville, Wis., succeeding **M. E. Ash**, appointed chairman and chief executive officer. Mr. DePolis was vice president-marketing at LeTourneau-Westinghouse Corp. **George Mallinckrodt** resigns as chairman. **James A. Driessen** resigns as executive vice president, effective Dec. 31.

William J. Cleary Jr. was made general manager-carbon sales, **McLouth Steel Corp.**, Detroit. **Wallace H. Adamson** was named general manager-stainless sales; **Harry D. Anderson** general manager-stainless distributor sales.

Walter L. Saccani was appointed superintendent, Oxygen Steel Production Dept., at **Kaiser Steel Corp.'s** Fontana, Calif., plant. **William A. Bringman** was made assistant superintendent, Open Hearth Steel Production Dept. **Jay I. Dodson** was made superintendent, Metallurgical Dept.

John I. Snyder Jr. was elected chairman and chief executive officer of **General Aniline & Film Corp.**, New York, to succeed **Thomas A. Morgan**, retired. Mr. Snyder, former vice chairman, is president and chairman of U. S. Industries Inc. **Ross D. Siragusa** was elected vice chairman. He is president and chairman of Admiral Corp.

Richard Baubles was made assistant chief product engineer, **Elastic Stop Nut Corp. of America**, Union, N. J.

John B. Gage was made special products manager for **Quaker State Metals Co.**, Lancaster, Pa.

Loy C. Collinwood was appointed manager, Alloy Metal Wire Works plant of **Riverside-Alloy Metal Div.** at Prospect Park, Pa., H. K. Porter Company Inc. He was assistant gen-

ROBERT M. BURFORD

Pennsalt Chemicals post

WILLIAM J. CLEARY JR.

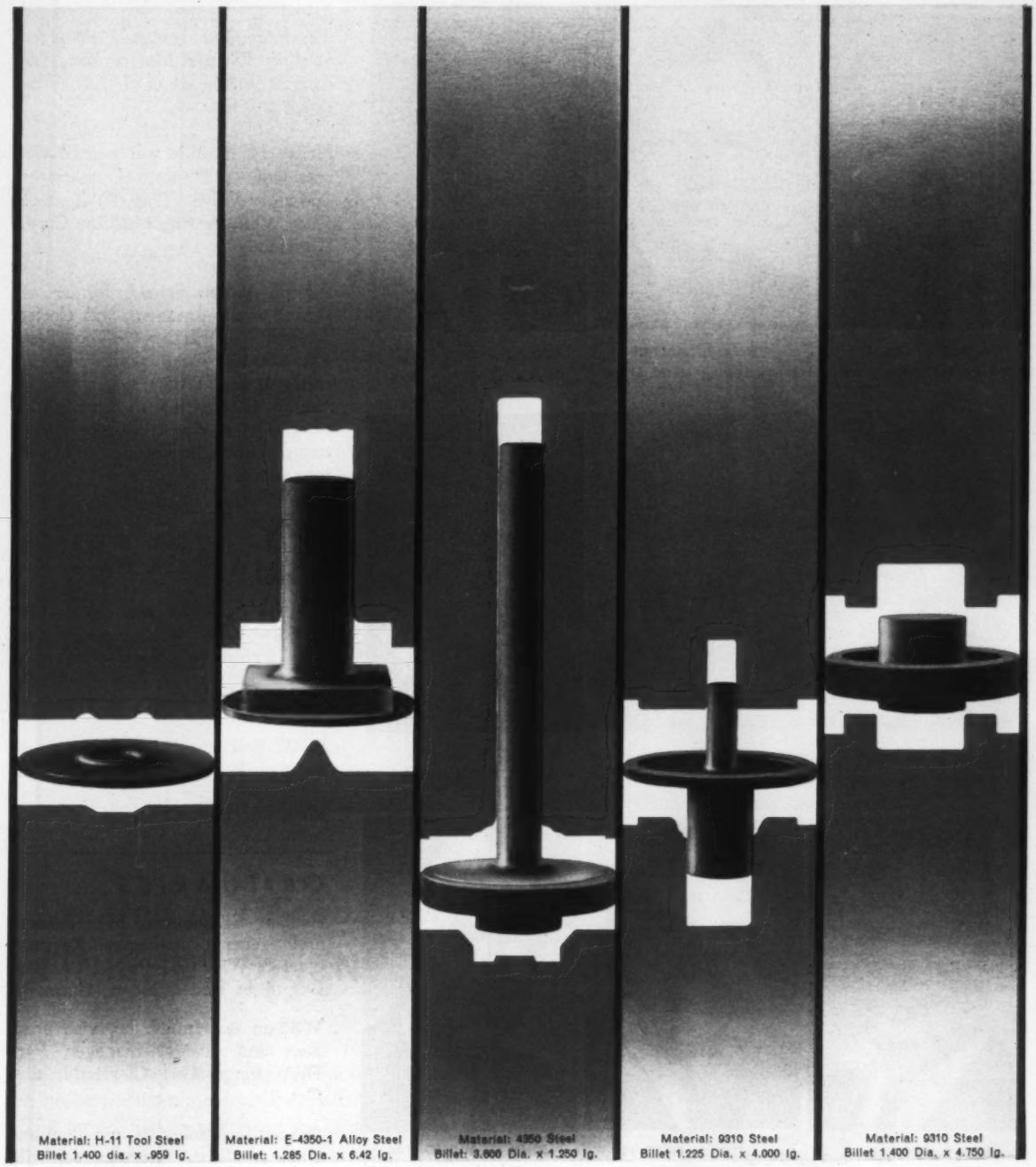
McLouth carbon sales

WALTER L. SACCANI

Kaiser Steel dept. supt.

LOY C. COLLINGWOOD

Riverside-Alloy post


Material: H-11 Tool Steel
Billet 1.400 dia. x .959 lg.
Material: E-4350-1 Alloy Steel
Billet: 1.285 Dia. x 6.42 lg.
Material: 4350 Steel
Billet: 3.600 Dia. x 1.250 lg.
Material: 9310 Steel
Billet 1.225 Dia. x 4.000 lg.
Material: 9310 Steel
Billet 1.400 Dia. x 4.750 lg.

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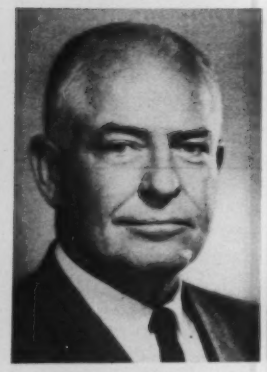
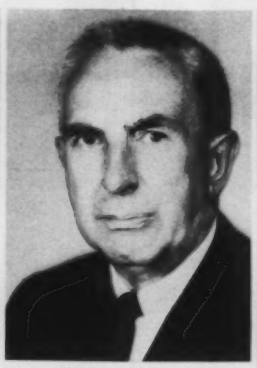
JAMES W. VOLK
Brillion exec. v. p.

WILLIAM B. WHITE
High Vacuum v. p.

E. W. BELL
joins A & C Engineering



JOSEPH D. HITCH JR.
B&W international sales



LYTTLETON PRICE JR.
Rheem Mfg. group v. p.

JOHN G. MUNSON Jr.
U. S. Steel exec. post

eral sales manager for Riverside-Alloy.

Joseph D. Hitch Jr. was made general manager, international sales of **Babcock & Wilcox Co.'s** Boiler Div., New York.

Lyttleton Price Jr. was promoted to vice president-research and development of **Rheem Mfg. Co.'s** Home Products Group, Chicago.

John G. Munson Jr. was made assistant to administrative vice president-production, **United States Steel Corp.**, Pittsburgh. He succeeds **H. W. Seyler**, retired. Mr. Munson was general superintendent, Fairfield Coke & Coal Chemical Works, Tennessee Coal & Iron Div. He will also serve as chairman of the corporation's operating committee for coke and chemical products, succeeding Mr. Seyler.

Alfred E. Grazen was appointed president and general manager, **Sterling Electric Motors Inc.**, Los Angeles, subsidiary of Hathaway Instruments Inc.

Henry H. Maltbie was named vice president and general manager, Specialty Valve, Trap & Controls Div., **White Sewing Machine Corp.**, Cleveland.

Adolph Joseph Scheid, former assistant to the president, was elected president of **Columbia Tool Steel Co.**, Chicago Heights, Ill. He succeeds **Arthur T. Clarage**, who continues as chairman. **Adolph J. Scheid Jr.** retires as vice president-manufacturing technology and quality control.

James W. Volk was named executive vice president, **Brillion Iron Works Inc.**, Brillion, Wis.

William B. White was elected vice president-administration, **High Vacuum Equipment Corp.**, Hingham, Mass., subsidiary of Robinson Technical Products Inc.

E. W. Bell joined **A & C Engineering Co.**, Warren, Mich., as general manager in charge of engineering, sales, and manufacturing.

OBITUARIES...

Reuben E. Sommer, 61, president and general manager, **Keystone Steel & Wire Co.**, Peoria, Ill., died Oct. 8 in Baden-Baden, Germany.

William A. Humel, 66, vice president and general manager, **Park Drop Forge Co.**, Cleveland, died Oct. 9.

Samuel Jacobsohn, 63, president and chief physicist, **Gaertner Scientific Corp.**, Chicago, died Oct. 5.

Howard J. Daly, 64, a vice president, **Norton Co.**, and general manager of its electric furnace plant in Niagara Falls, Ont., died Oct. 7.

G. A. Milton Sr., 72, founder and past president, **George A. Milton Can Co.**, Brooklyn, N. Y., died Oct. 1.

M. E. Whitehead, 70, vice president, **Barth Smelting Corp.**, Newark, N. J., died Sept. 30.

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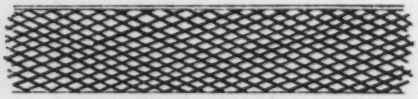
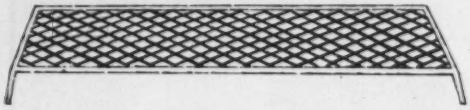
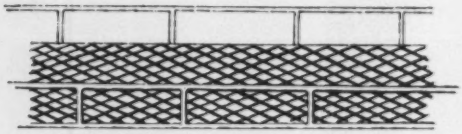
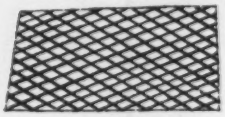
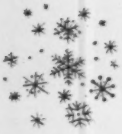
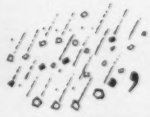
In Canada: The Glidden Company, Ltd., Toronto, Ontario

Today, you'll find more and more walkways  , stairs , mezzanines  and skywalks  are made of Wheeling Expanded Metal  .

That's because unwanted rain , snow  , sleet  , mud , oil and grease go right through it . So does light , heat and fresh air . No wonder it pays to specify Wheeling Expanded Metal!

Wheeling

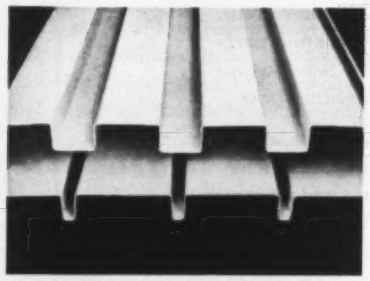
WHEELING CORRUGATING COMPANY • IT'S WHEELING STEEL!

Steel

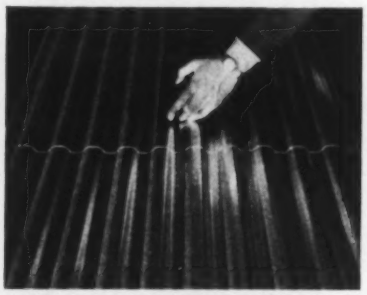
Warehouses: *Boston, Buffalo, Chicago, Columbus, Detroit, Kansas City, Louisville, Martins Ferry, Minneapolis, New York, Philadelphia, Richmond, St. Louis.* Sales Offices: *Atlanta, Houston, New Orleans.*

OTHER WHEELING PRODUCTS

Wheeling Continuous Weld Steel Pipe gives strong, dependable, low-cost service . . . usually outlasts the building itself.

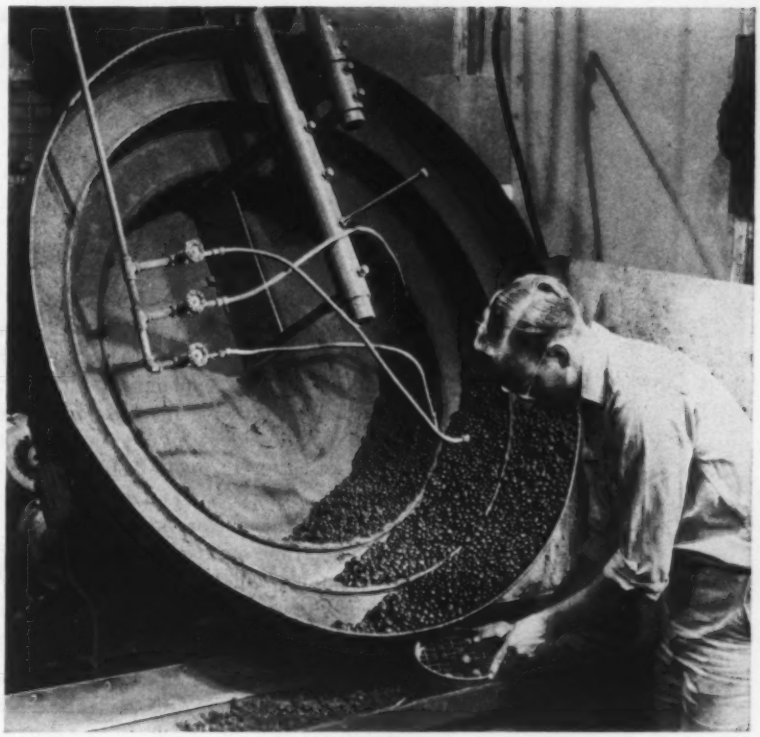


NEW, STRONGER Wheeling Super-Rib Steel Roof Deck has an exclusive vinyl protective coating . . . comes in unlimited lengths.



Wheeling Tensilform® . . . with conventional or light aggregate concrete . . . gives structures excellent lateral stability.

Wheeling SofTite® Cop-R-Loy® Galvanized Steel Sheets, for heating and air-conditioning ducts, will not flake or peel under rough use.



This pelletizer is housed in new laboratories as . . .

Bethlehem Consolidates Research

THE IMPROVEMENT of present products and processes and the development of new products and processes are the basic goals of researchers at Bethlehem Steel Co.'s new Homer Research Laboratories at South Mountain, Bethlehem, Pa. The $25 million center was formally dedicated Oct. 9.

Activities cover many technological fields, including process metallurgy, chemical engineering, physical metallurgy, mechanical engineering, ceramics, physics, corrosion engineering, chemistry, mineralogy, electronics, mechanics, thermodynamics, and nuclear studies. Research will involve bench scale work in laboratories and pilot manufacturing plants.

Efforts will be made to keep pace with the ever increasing demands of the Space Age and to meet the growing threats of foreign steel competition and competition from other domestic materials.

A total of 475,000 sq ft of floor area are provided in the five main structures: Administration & Bench Laboratory, Shops & Warehouse, Process Metallurgy, Photography, and Central Heating & Refrigeration. Two buildings are under construction: Electromechanical and Mechanical Engineering.

Speaking at the dedication ceremonies, Arthur B. Homer, chairman, said that while new products attract more attention than any other research and development activity, a great deal of emphasis will be put on the preparation of raw materials and the steelmaking process itself. He suggested that the next ten years might bring about much greater instrumentation and the use of automatic controls to keep pace with refinements in the steelmaking process. He also predicted an increase in automatic controls at the mill stage.

Among possible developments, Mr. Homer cited: Low cost tonnage prod-

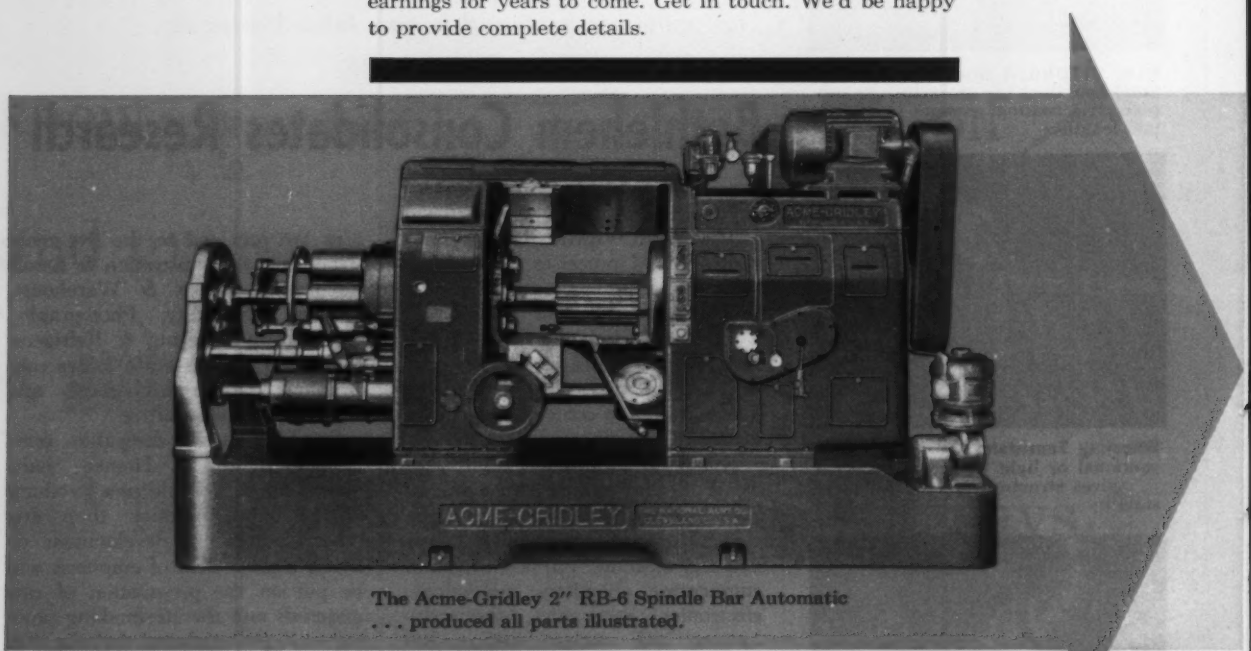
(*Please turn to Page* 108)

ACME-GRIDLEYS CUT AVERAGE MACHINE TIME 75%

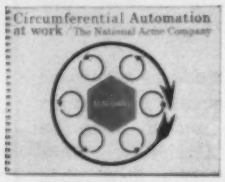
HELP HARDINGE BROTHERS HOLD THE LINE ON END PRODUCT PRICES

"There's no question about it . . . Acme-Gridley Bar Automatics are one of the reasons we haven't raised prices of our precision machines and attachments since 1956! And here's why" explains H. A. Lundy, Vice President of Hardinge Brothers, Inc., Elmira, New York, "when we need over 250 identical precision parts that can be grouped with other parts made from the same size bar, the job automatically goes on an Acme-Gridley. By switching jobs like those shown from conventional turret lathes, we reduce machine time an average 75% including setup time. With this kind of efficiency, it is economical to stockpile parts far beyond our immediate requirements, and take advantage of lower part costs to hold the line on selling price."

As Mr. Lundy says . . . there's no question about it. For short as well as long runs of identical precision parts, Acme-Gridleys are a sure way to cut production costs and increase earnings for years to come. Get in touch. We'd be happy to provide complete details.



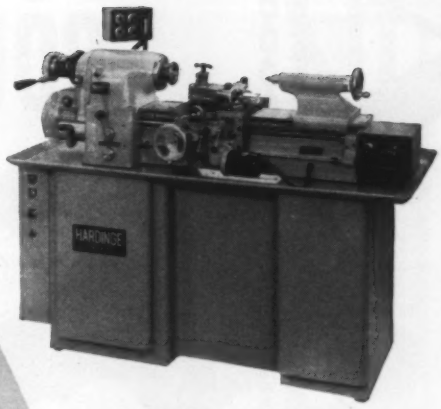
The Acme-Gridley 2" RB-6 Spindle Bar Automatic . . . produced all parts illustrated.



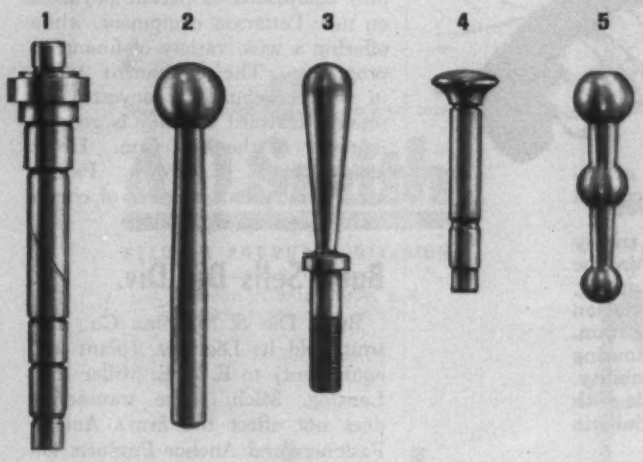
The number of *different* jobs that can be set up on any Acme-Gridley amazes everyone. To give you some idea, we've described some 57 actual jobs in a new 64-page bulletin called "Circumferential Automation at Work". For your free copy, call, write or wire.

HARDINGE PRODUCTION RECORDS ILLUSTRATE ACME-GRIDLEY SHORT RUN EFFICIENCY...

1 8620 Steel Clutch Cam. Run of 500 at 67 seconds per piece... 76.8% machine time reduction over previous method.
2 Rycase Steel Handle for Tailstock. Run of 850 at 59 seconds per piece...76.3% machine time reduction over previous method.
3 Rycase Steel Handle for Nut. Run of 1,100 at 61 seconds per piece . . . 72.2% machine time reduction over previous method.
4 Rycase Steel Spindle Lock Pin. Run of 500 at 59 seconds per piece... 76.3% machine time reduction over previous method.
5 C1117 (leaded) Steel Crank for Screw. Run of 2,000 at 44 seconds per piece . . . 89.2% machine time reduction over previous method. (All machine time reductions include setup time.)



The Hardinge HLV-H
Tool Room Lathe



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ELMIRA, N.Y.

CIRCUMFERENTIAL AUTOMATION

National Acme

Sales Offices: Newark 2, N.J.; Chicago 6, Ill.; Detroit 27, Mich.

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Acme Company
189 E. 131st Street
Cleveland 8, Ohio

JF Series

SAFE, RELIABLE POSITIVE CONTROL

Convenience, positive control and protection for the operator are provided by the pistol-grip, push-button control station of the Coffing Quik-Lift electric hoist.

Loads can be raised or lowered while pulling a trolley mounted hoist since a strain cable is incorporated in the control cord. The control station is made of non-conducting, impact resistant plastic and the 115 volts at the station plus the interlocked push buttons make for safe operation. The V-type brake assures positive control of loads. Housing is of strong but light aluminum which makes for portability.

Ask your distributor about the twenty JF models with capacities ranging from ¼ to 2 tons or write for Bulletin ADH-65BB.

COFFING HOISTS

DUFF-NORTON COMPANY

Four Gateway Center, Pittsburgh 22, Pennsylvania

COFFING HOISTS
Ratchet Lever • Air
Hand Chain • Electric

DUFF-NORTON

DUFF-NORTON JACKS
Ratchet • Screw
Hydraulic • Worm Gear

(*Concluded from Page* 105)

ucts with greater strength and durability; structural steels which may develop into a whole new family; new high strength steels for tonnage products, such as shapes and plates; new kinds of coated or alloyed steels able to resist a wide range of corrosive conditions; processes by which metals like chromium, titanium, and aluminum are diffused into the surface layers of sheet steel; and methods to combine plastic compounds and steel.

Western Cold Drawn Steel

Status of Western Automatic Machine Screw Co., Elyria, Ohio, a division of Standard Screw Co., is unchanged, including its staff of officers. Names of officials listed on p. 106 of the Oct. 9 issue of STEEL are those of Standard Screw Co.'s Western Cold Drawn Steel Div., formerly the Cold Drawn Steel Plant of Western Automatic.

Offers Financing Program

Patterson Foundry & Machine Co., East Liverpool, Ohio, has organized a subsidiary, Process Equipment Trading Co., to take in surplus equipment as partial payment on new Patterson equipment, while offering a wide variety of financing programs. The equipment taken in will be rebuilt or converted for resale. Howard Crossley is general manager of the new firm. He is assisted by N. E. Brown. Patterson Foundry is a supplier of chemical processing equipment.

Buell Sells Die Div.

Buell Die & Machine Co., Detroit, sold its Die Div. (plant and equipment) to E. & E. Miller Inc., Lansing, Mich. The transaction does not affect the firm's Anchor Fasteners and Anchor Products Divisions.

Air Reduction Builds

Air Reduction Pacific Co., San Francisco, a division of Air Reduction Co. Inc., is expanding its air separation plant at 731 W. Cutting Blvd., Richmond, Calif. The expanded facilities will more than double the present production, increasing total daily output of liquid

A. O. Smith electrodes are strictly top shelf

When you reach for an A. O. Smith electrode, you've reached a high point in quality. We're not stretching that point when we say that our electrodes are backed by the industry's strictest quality control program. We test 'em by eye! We test 'em mechanically! We test 'em electronically! We weld test 'em after baking. We do everything humanly possible to assure top performance welds.

We think we know a good thing when we weld with it. You will too when you reach for an electrode made by A. O. Smith.

Through research ... *a better way*

A.O.Smith
CORPORATION

WELDING PRODUCTS DIVISION
Milwaukee 1, Wisconsin
A. O. Smith INTERNATIONAL S. A.
Milwaukee 1, Wisconsin, U. S. A.

LET MUELLER MAKE IT!

Mueller Brass Co. of Port Huron is much more diversified than the name "Brass" implies . . . a lot more. In fact, because of its many and varied facilities . . . its *men, methods* and *metals* . . . Mueller is in the unique position of being able to offer true single source service.

MUELLER HAS THE MEN . . . experienced engineers with the ability to work out, creatively, tough design problems, and improve a part or components for production by the most economical method. You get sound engineering plus 44 years of practical metalworking production experience when you "Let Mueller Make It."

MUELLER HAS THE METHODS . . . when you "Let Mueller Make It", you are utilizing one single source that is able to produce parts any one of these ways: as forgings, impact extrusions, sintered metal parts, screw machine products, formed tube or as castings.

MUELLER HAS THE METALS . . . and the materials . . . to produce precision parts in aluminum, brass, bronze, copper, iron, and steel in hundreds of different alloys to meet each exact requirement.

In addition, Mueller Brass Co. has complete and modern facilities for performing all types of finishing and sub-assembly operations. Another plus value is nation-wide sales engineering service.

So, in the final analysis, no matter where you fit in the American industrial picture, whether you're making missiles or mowers . . . and no matter where you're located, it will pay you to LET MUELLER MAKE IT!

MUELLER BRASS CO.
PORT HURON 26, MICHIGAN

oxygen, nitrogen, and argon to about 200 tons. Completion of the project is set for March, 1962.

Stelco to Build Wide Sheet Mill

COLD ROLLED steel sheets up to 72 in. wide will be made in Canada. They will be produced on an 80 in., four stand, four high mill to be constructed by the Steel Co. of Canada Ltd. in Hamilton, Ont. Stelco says the widest sheets made in Canada today are 60 in.

"The demand by major industries for wider hot and cold rolled sheets has been increasing," says V. W. Scully, president. "The company's decision to equip itself to meet this demand marks an important forward step toward making Canada more self-sufficient.

"In building this mill, we shall purchase the major portion of the necessary equipment in Canada . . . and provide job opportunities for many Canadians.

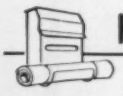
"Only components which cannot be made in this country will be bought elsewhere. This is in line with our policy of supporting Canadian industry to the greatest feasible extent."

L. T. Craig, vice president, says the mill may enable Canada to ship steel to the U. S. where it could be used on automobiles built there for sale in Canada.

The wider cold rolled sheets will also mean a saving in construction costs since they will be more convenient in some types of building.

Tata to Buy Equipment

Tata Engineering & Locomotive Co., Jamshedpur, India, plans to purchase metal cutting and forming equipment for expansion of its truckmaking facilities. Bid deadline is Oct. 20 at Tata Inc., 425 Park Ave., New York 22, N. Y.



NEW ADDRESSES

Electric Autolite Co., Toledo, Ohio, transferred its **Dial Thermometer Div.** from Port Huron, Mich., to Marshalltown, Iowa. The division will be added to the manufacturing facilities of Marshalltown Mfg. Inc., a subsidiary of the Toledo firm.

Elion Instruments Inc. relocated its general offices and plant at Route U. S. 130 North, Burlington, N. J.

ASSOCIATIONS

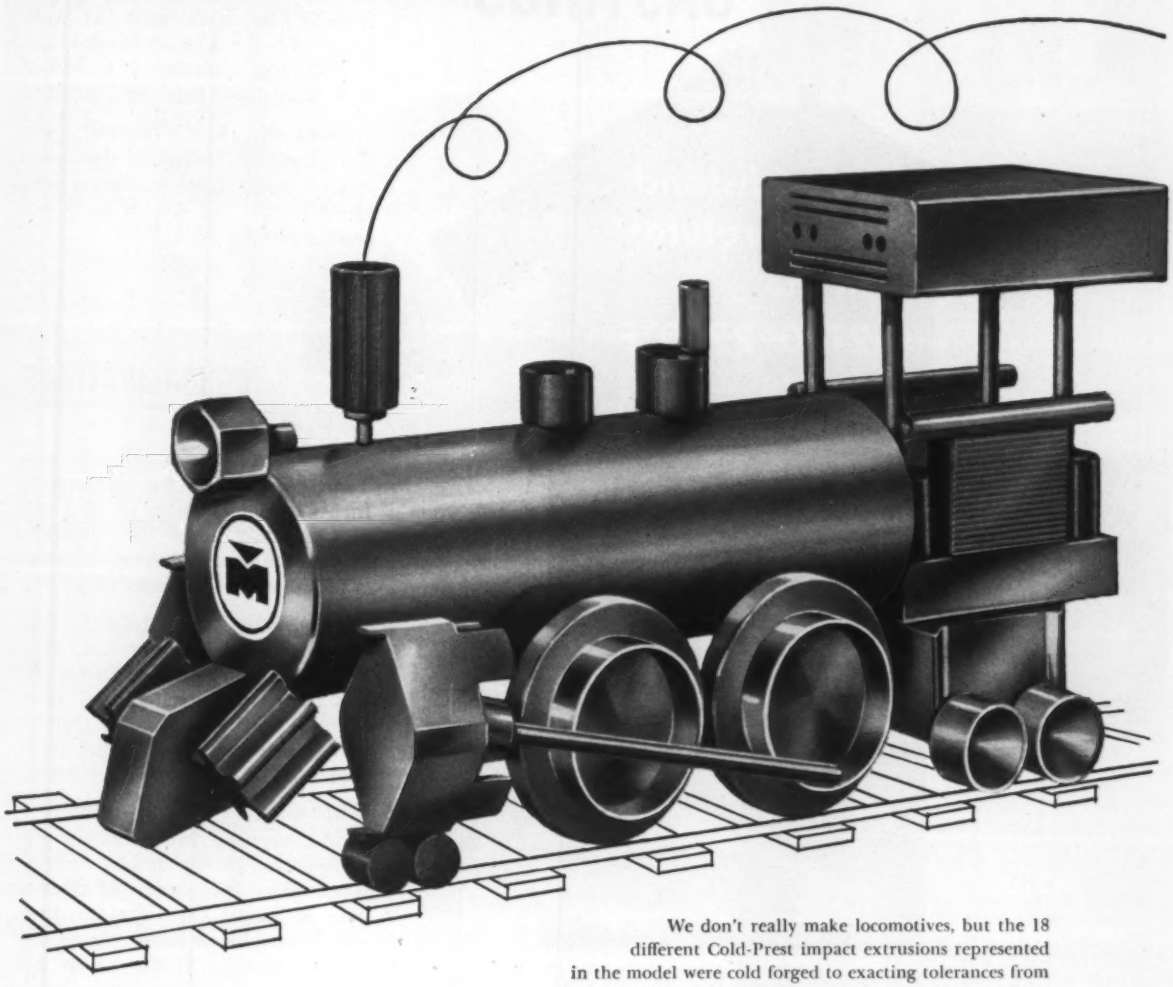
E. V. Huggins, Westinghouse Electric Corp., Pittsburgh, was reelected president of the **National Security Industrial Association,** Washington. Other officers are: Chairman, board of trustees, G. J. Lynch, Ford Motor Co., Dearborn, Mich.; vice chairman, Dr. Fordyce Tuttle, Eastman Kodak Co., Rochester, N. Y.; and first vice president, Thomas Meloy, Melpar Inc., Falls Church, Va.

American Management Association will move the headquarters of its national and international organizations to the 23 story, 700,000 sq ft office building being erected at 135 W. 50th St., adjacent to the Time & Life Bldg. and the Rockefeller Center complex, New York.

The Association elected these new vice presidents to head operating divisions: General Management Div., A. F. Vinson, New York, General Electric Co.; Mfg. Div., H. Gordon Fromm, Dover, Del., International Latex Corp.; Marketing Div., J. C. Richards, Akron, B. F. Goodrich Industrial Product Co.; Packaging Div., L. R. Srigley, Detroit, Parke, Davis & Co.; and Research & Development Div., D. H. Ewing, Princeton, N. J., David Sarnoff Research Center, Radio Corp. of America.

American Production & Inventory Control Society, Kokomo, Ind., elected these officers: President, D. F. Hess, Bearings Co. of America, Lancaster, Pa., a division of Federal-Mogul-Bower Bearings Inc.; executive vice president, Isidore Eisner, Averovox Corp., New Bedford, Mass.; vice president-education and research, R. F. Woelfle, Day-Brite Lighting Co., St. Louis; vice president-public relations, Donald

MUELLER CAN MAKE MOST ANYTHING IN IMPACT EXTRUSIONS...



We don't really make locomotives, but the 18 different Cold-Prest impact extrusions represented in the model were cold forged to exacting tolerances from a number of aluminum, copper, brass, and steel alloys.

These parts are employed in products ranging from door closers to missiles. Mueller has also made important advances in the production of copper impact extrusions that are especially adaptable to electronic applications. Cold forgings are precision produced to exacting tolerances and offer the additional advantage of a better finish and appreciable metal savings.

Mueller's flexible facilities for the production of Cold-Prest Impact extrusions make practical long or short runs of simple or relatively complex shapes on an economical basis. In addition, the entire Mueller engineering staff, excellent machining, finishing and assembly facilities are readily available to you when you . . .

LET MUELLER MAKE IT!

MUELLER BRASS CO.

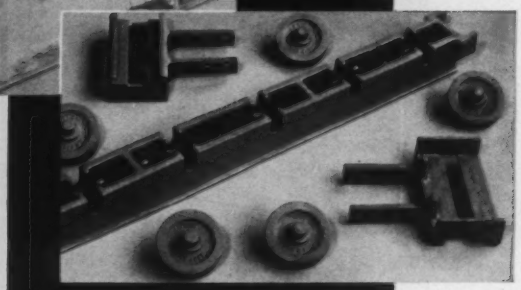
PORT HURON 26, MICHIGAN

Write today for Engineering Manual No. FM-3019

344

HOM CASTINGS

...to withstand temperatures in the 2100-2200°F range



The castings shown are for high temperature heat-treating furnaces. They are cast of a special HOM alloy, developed by Duraloy Metallurgists to meet the increasingly higher temperatures now confronting the metal working industries.

HOM is an alloy that retains considerable strength over a broad working area at 2200°F. It can be used for limited applications at 2300°F.

Duraloy Metallurgists—as exemplified by this HOM development—are always on the alert to broaden their service to industry. They have the knowledge, experience and equipment to make good high alloy castings for your requirements whether static, centrifugal or shell-molded. Bulletin G-261 gives full details.

DURALOY

ALLOY CASTING INSTITUTE ACI MEMBER

The DURALOY Company

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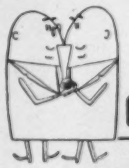
CHICAGO OFFICE: 332 South Michigan Ave., Chicago, Ill.
DETROIT OFFICE: 1025 Maple Road, Troy, Michigan
HOUSTON OFFICE: 4101 San Jacinto, Houston 4, Texas

Kasperek, Electronics Components Div., Bradford, Pa., Corning Glass Works; vice president-chapter development, Robert Ross, Moog Servocontrols Inc., East Aurora, N. Y.; secretary, Gordon Kageff, Bulldog Electric Products Co., a division of I-T-E Circuit Breaker Co., Detroit; and treasurer, J. F. Miller, SKF Industries Inc., Philadelphia.

Frank N. Ikard, Wichita Falls, Tex., has been named to the newly created position of executive vice president of the **American Petroleum Institute**, New York.



CONSOLIDATIONS

Harriman Mfg. Co., Chattanooga, Tenn., acquired **Rulco Engineering Inc.**, Cleveland, maker of steel rule dies, and has moved the operations to Chattanooga. Warren Mosman is president of Harriman Mfg.

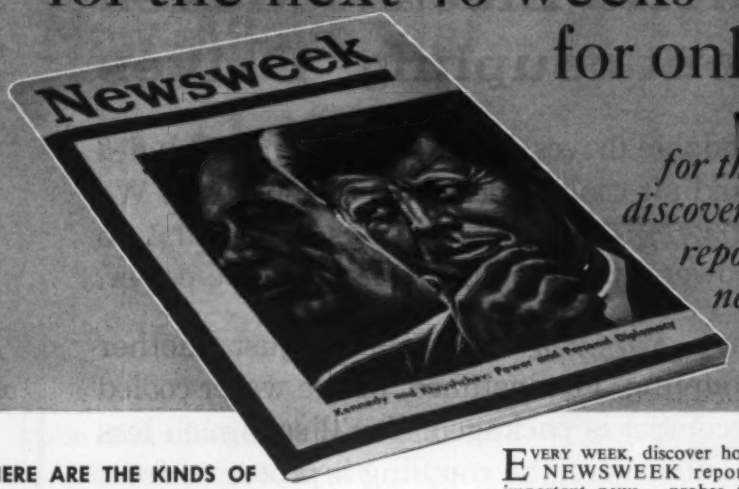
Jomac Inc., Philadelphia, purchased **National Roller Co.**, New York. H. Howard Colehower III has been appointed interim manager of the new subsidiary, which makes printing rollers and industrial rolls.

Mertronics Corp., Santa Monica, Calif., acquired two precision machining companies in Los Angeles: **Acrosonics Inc.** and **Hollywood Mfg. & Supply Co.** The two firms will be combined to form a subsidiary, Acrosonics Corp., which will also operate a facility known as the Hollywood Mfg. Div. Officers of the subsidiary are: President, F. H. Lewis; vice president and general manager, Dewel Morrison; treasurer, Kenneth Boyd; and secretary, H. J. McAfee.

Allis-Chalmers International Div., Allis-Chalmers Mfg. Co., Milwaukee, acquired **Jones Balers Ltd.**, which is about 20 miles from Liverpool, England. The firm will be operated as a subsidiary of Allis-Chalmers Great Britain Ltd.

Wheelabrator Corp., Mishawaka, Ind., acquired **W. W. Criswell Co. Inc.**, Riverton, N. J., manufacturer of filtration products. W. W. Criswell, president, will continue to operate the New Jersey firm.

An invitation to read **Newsweek** for the next 40 weeks for only $2.97



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- What big breakthroughs are near in the treatment of cancer? Crippling arthritis? Cerebral palsy?
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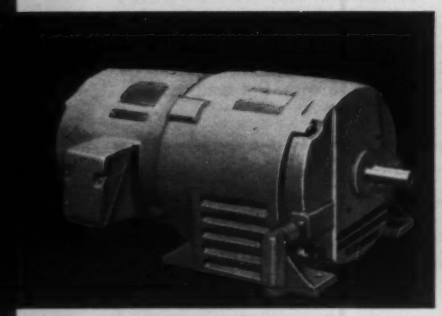
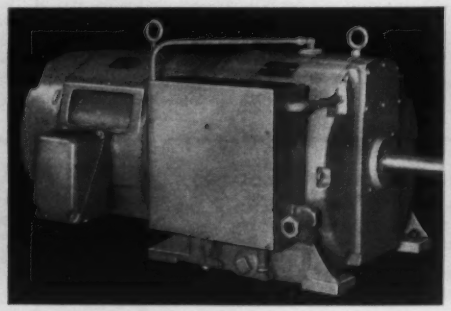
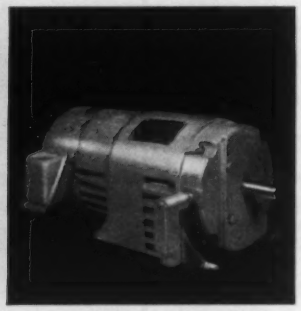


AIR COOLED, 7-1/2 to 100 HP



WATER COOLED, 25 to 150 HP



AIR COOLED, 1 to 5 HP

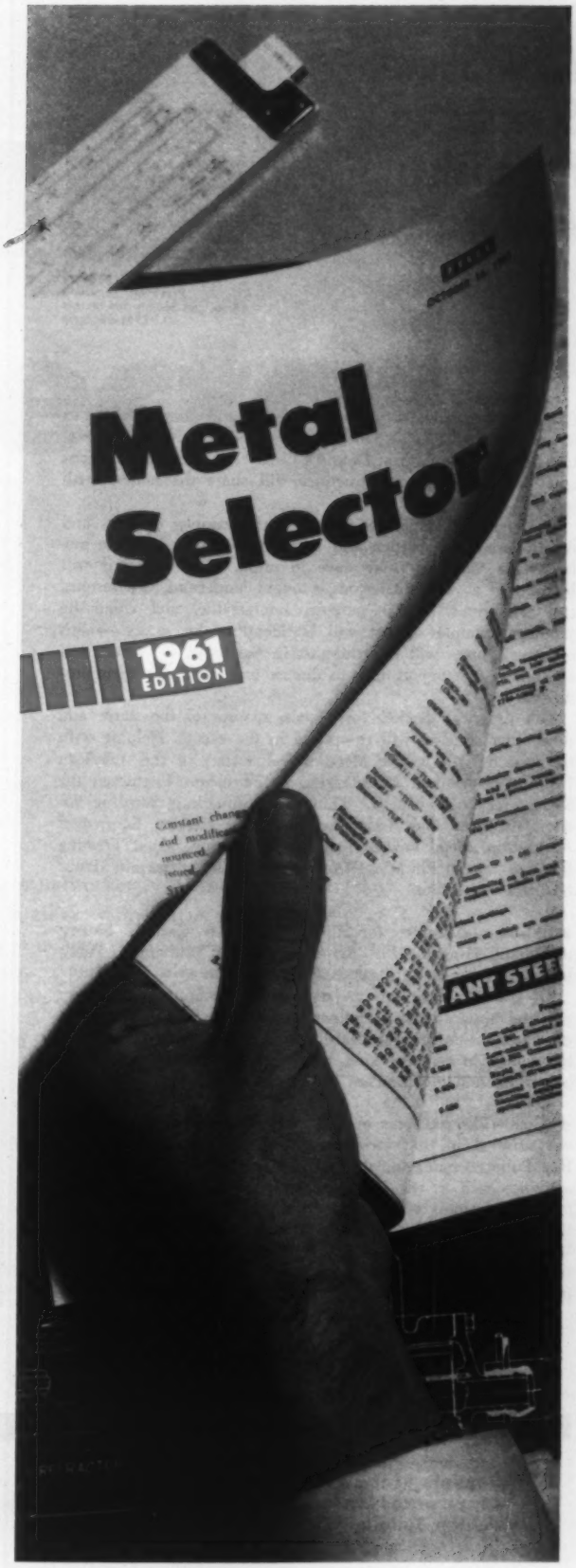
DIRECT CURRENT MOTOR AND GENERATOR DEPARTMENT

GENERAL ELECTRIC

ERIE, PENNSYLVANIA

New Alloys Star In '61 Metal Selector

Up to date information from close to 100 sources covers broad range of ferrous and nonferrous metals. Heat treaters, metallurgists, designers, purchasing agents will find it helpful



• INEXORABLE . . . accelerating . . . exponential.

Any of those words could be used to describe the changes in metals and metalworking. This 1961 edition of STEEL's award winning Metal Selector will give you ample proof.

In compiling last year's selector, more than 1100 changes were made. This year, about 1400 were required.

• **The first change: A section on refractory metals replaces the vacuum melted alloys section in last year's version.**

The growing importance of the refractory metals group (see STEEL, May 8, p. 115) warranted the move. Some refractory metals were included in the vacuum melted and high temperature alloy sections last year; others are listed for the first time. Metalsmen accustomed to thinking of tungsten and molybdenum in terms of filaments or elements for lamps and vacuum tubes will be surprised by the variety of applications for those and other refractory metals. Tungsten has a high density (nearly 20 times that of water) and is one of the components of "heavy metal" alloys; such alloys may be used in aircraft because their concentration of weight makes more efficient—and therefore lighter—gyros possible. Columbium takes high temperatures and is being so used; it's also finding service at cryogenic temperatures—as a component in a superconducting alloy. Columbium and tantalum are being used in chemical

ASM Show Stresses Materials Approach

Carl E. Swartz
President nominate
American Society for Metals
1961-62 term

GROWING awareness of the interrelationships among materials of construction: That will be evident at the 43rd National Metal Congress & Exposition at Detroit's Cobo Hall, Oct. 23-27. Nonmetallics and composite structures will share the honors with metals.

A Materials Comparison Center, with examples of parts and descriptions of properties, will help Show visitors compare materials for jobs they may have in mind. The materials will be grouped as wrought ferrous, wrought nonferrous, cast ferrous, cast nonferrous, special purpose, nonmetallic, and composite products. Samples shown will be identified by sources—many of these sources will be exhibitors in the show, so visitors will often have the opportunity to discuss materials with their producers.

The American Society for Metals, sponsor of the show, and nine other societies will co-operate in the event. Helping with the sessions will be the Metallurgical Society of the American Institute of Mining, Metallurgical & Petroleum Engineers, the Society for Nondestructive Testing, the American Welding Society, American Gas Association, Industrial Heating Equipment Association, Metal Powder Industries Federation, Metal Treating Institute, Special Libraries Association, and the Ultrasonic Manufacturers Association.

● **Business**—Nominee for ASM president is Carl E. Swartz, consultant, Hinsdale, Ill. Retiring President William A. Pennington will serve as trustee next year.

On the schedule are an engineering program, directed at practical applications; a seminar on ultrapure metals; and technical sessions on metallurgical theories, refractory metals, vacuum technology in metalworking, nuclear problems, and the effects of surface and environment on strength.

● **Goal**—The problems of time and technology will determine our survival in the world marketplace or in war, says Allen Ray Putnam, managing director of the ASM. He believes that activities such as the show can help shorten the time lag between conception of an idea and its incorporation into practical hardware. The results of research and development can be offered to those who can utilize the developments, making activities such as the show an intensive course in current technology, Mr. Putnam adds.

equipment because of their corrosion resistance.

Although the section on vacuum melted alloys was dropped, we did not eliminate all the materials from the new Selector. Where there was no duplication, they were placed in other appropriate sections, particularly the high temperature alloys category. Several vacuum processing methods are in commercial use today. Each has its own characteristics. Some producers employ more than one method, the choice depending on the metal and the results needed. And most of the metals being made can be obtained as a vacuum melted product from one or more manufacturers.

● **Another section of the Selector includes the new copper alloy numbers.**

Members of the Copper & Brass Research Association have developed a group of numbers to identify copper base alloys. The newcomers, which you will find with the wrought copper alloys and in the copper section of the spring alloys section, aid in classifying the copper base metals. The system uses three digit numbers to avoid confusion with other systems that have four digit classifications.

The older names for the copper base alloys are continued in the Selector; they may persist for a long time, as have such older chemical terms as sal ammoniac and niter cake. Some of the names have been confusing: There's no gold in gilding metal. Hardware bronze has no tin in it. Both aluminum bronze and nickel silver are copper base alloys. Use of the new numbers will help resolve the problem.

● **Many changes will be found in the high strength steels section.**

These popular materials have grown considerably in number since the last issue of the Selector. Casualties include a few no longer produced and a few marketed under names different from those originally used. Additions far outnumber deletions, so the section is larger than ever before. Since last year, minor changes have been made in the analysis of a few alloys.

● **Some sections are relatively unchanged.**

The cast high alloys, alloy steel, H steel and stainless steel sections show few changes since last year. They provide a wide selection within the standard materials, so changes have been in applications rather than in analysis in most cases.

EXTRA COPIES AVAILABLE

Reprints of the 1961 edition of the Metal Selector are available at 50 cents per copy; prices for larger quantities on request. Write: Reprint Department, STEEL, Penton Building, Cleveland 13, Ohio.

STEEL
OCTOBER 16, 1961

Metal Selector

1961 EDITION

Constant change is the rule in metalworking. New metals and alloys and modifications of the more familiar compositions are frequently announced. Reference books begin to become out of date as soon as they are issued. We include improved products and new ones made available since STEEL's 1960 selector was issued in this edition.

The Metal Selector is a continuing service to our readers. It is the most up to date single source of information on metals and alloys.

- It covers 20 categories of ferrous and nonferrous metals.
- It has more than 1000 product listings.
- The new copper numbers of the Copper and Brass Research Association are included.
- It includes a new section on refractory metals.

Please turn to the inside front cover of this section for a listing of the contents of this 32 page Selector.

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REFRACTORY METALS

Designation	Producer	Composition %	Properties & Applications
TUNGSTEN ALLOYS			
Pure Tungsten	1, 2, 4, 6, 10, 11, 12, 13, 16, 17	W	Powder; rods; consumable electrodes; forging billets; sheets; formed parts, and wire. For use in missile and rocket parts, electrical contacts, semiconductor devices, lamp and electronic parts, including use as glass sealing material.
Tungsten-Columbium	4	W 99.50; Cb 0.50	
99 Metal	1	Ni 1.00; W bal	Missile hardware.
Tungsten-Tantalum	4, 14, 16	W 98.50; Ta 1.50	
98% W—2% Mo	11, 16	W 98.00; Mo 2.00	
Heavy Tungsten—W2	9	W 97.5; Ni 2.50	Shielding, isotope containers, refractory applications. Counterweights, rotational parts (gyro), electrical contacts.
Tungsten-3 Moly	4, 16	W 97.00; Mo 3.00	Rocket nozzles, rings, jet vanes, and guide vanes. Useful at temperatures exceeding 5500° F in high velocity gas streams over 6000° F.
Tungsten-5 Moly	4, 16	W 95.00; Mo 5.00	
Heavy Tungsten—W5 95 Metal	9	W 95.00; Ni 3.30; Cu 1.70	
Tungsten-7 Moly	4, 16	W 93.00; Mo 7.00	Rocket nozzles, rings, jet vanes, and guide vanes. Used at intermediate temperatures as high as 4500° F in high velocity gas streams.
Tungsten-10 Moly	4, 16	W 90.00; Mo 10.00	
Heavy Tungsten—W10	9	W 90.00; Ni 7.50; Cu 2.50	
77 Metal	1	Ni 7.00; Cu 4.00; W bal	Radiation shielding control devices.
Tungsten-15 Moly	4, 5, 11, 16	W 85.00; Mo 15.00	Missile hardware.
Tungsten-26% Rhenium	3	Re 26.00; W bal	Ultrahigh temperature thermocouples. (4000 to 5000° F.) High temperature structural parts. Good electrical properties.
Tungsten-25 Rhenium	18	W 75.00; Re 25.00	Improved ductility.
Tungsten-30 Moly	6	W 70.00; Mo 30.00	Missile hardware, intermediate temperature applications.
Tungsten-40 Moly	4, 16	W 60.00; Mo 40.00	
Tungsten-50 Moly	4, 6, 10, 16	W 50.00; Mo 50.00	
RHENIUM ALLOYS			
Rhenium	18	Re	
50 Re—50 Mo	3, 18	Re 50.00; Mo 50.00	Improved ductility, compared with molybdenum. Superconductive alloy.
TANTALUM ALLOYS			
Tantalum	1, 3, 7, 9, 12, 14, 15	Ta	Excellent corrosion resistance to almost all acids combined with high thermal conductivity. Useful to the chemical industry.
Tantalum-Tungsten	1, 3, 7, 12, 14, 16	Ta 90.00; W 10.00	Tensile strength over 7000 psi at 3500° F; more resistant to oxidation than pure tantalum. Missile components, surgical implants.
MOLYBDENUM ALLOYS			
Pure Molybdenum	1, 2, 4, 5, 6, 10, 11, 13, 16, 17	Mo	Missile and rocket parts; electrical contacts; semiconductor devices; lamp and electronic parts, including use as glass sealing material; arc casting. Electric and electronic parts; rocket nozzles; furnace parts; boring bars, grinding quills, wear resistant room temperature uses.
Molybdenum 0.50 Ti Alloy	4, 5, 11, 16	Ti 0.50; Mo bal	Piercer points; experimental gas turbine buckets and guide vanes. Useful strength at temperatures above 1600° F greater than that of any other commercially available material. Must be protected against oxidation at elevated temperatures.
Molybdenum-Ti-Zr	4, 5	Ti 0.50; Zr 0.10; Mo bal	Missile and rocket parts, diecasting cores, and similar high temperature parts. Hot strength and recrystallization temperature higher than those of molybdenum-0.5% titanium alloy.
Climelt Molybdenum—30% Tungsten	5, 6	W 30.00; Mo bal	Ultrahigh temperature service material. Has better corrosion resistance than unalloyed molybdenum in some mediums, such as molten zinc. Nozzles and other missile parts.
Molybdenum Rhenium	3	Mo 60.00; Re 40.00	Excellent superconductive properties. Excellent room temperature ductility. Good room temperature ductility and high temperature strength.
COLUMBIUM ALLOYS			
Columbium; D-10	1, 3, 4, 7, 8, 11, 12, 13, 15	Cb	Heat and corrosion resistant. Cryogenic applications. Second in corrosion resistance only to tantalum for most acids.
80 Metal	1	Zr 0.50; Cb bal	Chemical equipment.
Columbium + 1.0% Zirconium Haynes Alloy Cb751, D-11	4, 7, 8, 11, 12	Zr 1.00; Cb bal	More strength at higher temperatures than pure columbium; slightly increased corrosion resistance. Same applications as columbium.
D-12	8	5 Ti; Cb bal	Liquid metal heat exchangers.
D-14	8	5 Zr; Cb bal	High temperature strength, less oxidation resistant than D-31.
Columbium—7.5% V	7	V 7.50; Cb bal	Experimental for nuclear applications.
C-103	7	Hf 10; Cb bal	Available in production quantities. Excellent fabricability, ductility, and weldability; good structural material.
Haynes Alloy Cb-752; D-36	8, 12	W 10; Zr 5, Cb bal	Readily fabricated forms ductile weld joints; high strength columbium-base alloy.
D-31	7, 8	Mo 10.00; Ti 10.00; Cb 80.00	More resistant to high temperature oxidation than pure columbium and about 100 times as resistant as molybdenum. Ductile at room temperature in the cold worked and stress relieved condition.
Columbium—10% Hf—10% W	7	Hf 10.00; W 10.00; Cb bal	Good ductility.

(Continued on Page S-4)

REFRACTORY METALS (continued)

Designation	Producer	Composition %	Properties & Applications
F-48 Alloy	2, 7	Cb 79.00; W 15.00; Mo 5.00; Zr 1.00	Available in sheets and rods, for structural members, space vehicles, experimental gas turbine buckets, and guide vanes. Must be protected against oxidation at elevated temperatures.
Columbium-Tin	3	Cb_3 Sn Intermetallic Compound	Excellent superconductive properties.
Columbium-33 Zirconium	3, 8	Cb 67.00; Zr 33.00	Excellent superconductive properties.
82 Metal	1	Ti 32.00; Zr 0.50; Cb bal	Cryogenic electronics.
Columbium-33 Tantalum 0.75% Zirconium	4, 7	Ta 33.00; Zr 0.75; Cb bal	High temperature applications at relatively good strengths to 2200° F. Must be protected from oxidation.

HAFNIUM

Hafnium	7	Hf	Principal use: Control rods for nuclear applications. Excellent corrosion resistance to water and steam.

PRECIOUS METAL ALLOYS

Platinum	30, 31	Pt	Highly corrosive and oxidation resistant. Used for thermocouples, furnace windings, laboratory ware, catalysts, glass melting apparatus.
Platinum-Rhodium	30	Varies from 0-100% Rhodium	Highly corrosive and oxidation resistant with increased strength over platinum. Same applications as platinum when higher temperatures or increased stresses are encountered.
Rhodium	30, 31	Rh	Used where a highly reflective nontarnishing surface is required. Also used in special ceramic melting and laboratory ware.
Rhodium-Iridium	30	Varies from 0-100% Iridium	Used at very high temperatures (3200 to 4200° F) for thermocouples, laboratory ware.
Iridium	30, 31	Ir	Used for thermocouples, ceramic melting applications, and other highly specialized high temperature uses.
Palladium	31		
Ruthenium	31		
Osmium	31		

Key To Source:
1. Fansteel Metallurgical Corp., North Chicago, Ill.
2. General Electric Co., Lamp Metal & Component Dept., Cleveland.
3. Hoskins Mfg. Co., Detroit.
4. Universal-Cyclops Steel Corp., Bridgeville, Pa.
5. Climax Molybdenum Co., division of American Metal Climax Inc., New York.
6. Sylvania Electric Products Inc., Chemical & Metallurgical Div., New York.
7. Wah Chang Corp., Albany, Oreg.
8. E. I. du Pont de Nemours & Co. Inc., Wilmington, Del.
9. Kennametal Inc., Latrobe, Pa.
10. Philips Elmet Corp., Lewiston, Maine.
11. Oregon Metallurgical Corp., Albany, Oreg.
12. Haynes Stellite Co., division of Union Carbide Corp., New York.
13. Molybdenum Corp. of America, Pittsburgh.
14. National Research Corp., Cambridge, Mass.
15. Kawecki Chemical Co., Boyertown, Pa.
16. Firth Sterling Inc., Pittsburgh.
17. Metals & Residues Inc., Springfield, N. J.
18. Chase Brass & Copper Co., Waterbury, Conn.
30. Engelhard Industries Inc., Newark, N. J.
31. J. Bishop & Co., Malvern, Pa.

HIGH TEMPERATURE ALLOYS

Alloy	Composition %	Properties and Applications
TYPE: IRON-BASE ALLOYS		
H-40 (British)	C 0.23; Mn 0.30; Si 0.45; Cr 2.70	Gas turbine rotors, casings, castings, and other uses needing high creep strength up to 600° F.
ASTM A 213-60T		
Grade T2	C 0.10-0.20; Mn 0.30-0.61; P 0.045*; S 0.045*; Si 0.10-0.30; Cr 0.50-0.81	Composition of all grades not otherwise listed includes C 0.15*; Mn 0.30-0.60; P 0.03*; S 0.03*; Mo 0.45-0.65. T5c has a Ti content not less than 4 x C, but less than 0.70. These grades and modifications are offered by several suppliers as tradename products for superheater tubing and oil refinery use for temperatures as high as 1200° F; lower alloy ranges are used for lower temperatures.
Grade T3b	Si 0.50*; Cr 1.65-2.35	
Grade T5	Si 0.50*; Cr 4-6	
Grade T5b	Si 1-2; Cr 4-6	
Grade T5c	C 0.12*; Si 0.50*; Cr 4-6	
Grade T7	Si 0.50-1.00; Cr 6-8	
Grade T9	Si 0.25-1.00; Cr 8-10; Mo 0.90-1.10	
Grade T11	Si 0.50-1.00; Cr 1-1.50	
Grade T12	Mn 0.30-0.61; P 0.045*; S 0.045*; Si 0.50*; Cr 0.80-1.25	
Grade T17	C 0.15-0.25; Mn 0.30-0.61; P 0.045*; S 0.045*; Si 0.15-0.35; Cr 0.80-1.25; V 0.15	
Grade T21	Si 0.50*; Cr 2.65-3.35; Mo 0.80-1.06	
Grade T22	Si 0.50*; Cr 1.90-2.60; Mo 0.87-1.13	
Inductovac MCS	C 0.70; Si 1.05; Cr 3.50; Mo 5.50	High temperature bearings.

HIGH TEMPERATURE ALLOYS (continued)

Alloy	Composition %	Properties and Applications
TBS-600 (Timken)	C 1.00; Mn 0.70; Si 1.00; Cr 1.45; Mo 0.30	Bearing steel for high hardness and wear resistance to 600° F.
CBS-600 (Timken)	C 0.20; Mn 0.60; Si 1.10; Cr 1.45; Mo 1.00	Bearing steel for high hardness and wear resistance to 600° F.
TBS-1000 (Timken)	C 0.80; Mn 0.50; Si 0.50; Cr 1.05; Mo 5.00; V 1.05	Ball and roller bearings; used to 1000° F.
VSM	C 0.70; Mn 0.50; Si 1.10; Cr 3.00; Mo 5.25	High hot hardness, resistant to wear and abrasion at elevated temperatures. Used for valve seat inserts and stems, slides, guides, spindles, bearings.
Chromalloy (Unitemp 14 CMV)	C 0.20; Cr 1.00; Mo 1.00; V 0.12	Sheet metal casing on aviation gas turbines.
Unitemp 14 HV	C 0.45; Cr 1.00; Mo 0.55; V 0.30	Same as above and steam and gas turbine bolting.
17-22A	C 0.44; Si 0.65; Cr 1.25; Mo 0.50; V 0.25	Same as above.
17-22AS (Unitemp 14 MV)	C 0.30; Mn 0.55; Si 0.65; Cr 1.25; Mo 0.50; V 0.25	Steam and gas turbine bolting up to 1050° F; sheet metal casing assemblies. Axial-flow compressor blading at 800° F. Aircraft brakes. Compressor discs.
17-22 AV (Unitemp 14 MHV)	C 0.30; Si 0.65; Cr 1.25; Mo 0.50; V 0.85	High vanadium modification of above.
Unimach II (Thermold B)	C 0.35; Mn 0.45; Si 1.00; Cr 5.00; Mo 1.70; W 1.35	Ultrahigh strength for service up to 1000° F. Airframes, skin, fasteners, rivets, axles, rotors.
Thermold J	C 0.53; Mn 0.35; Si 1.00; Cr 5.00; Ni 1.50; Mo 1.75; V 1.00	Ultrahigh strength up to 1000° F. Tensile strength 230,000 psi at 1000° F; 75,000 psi at 1200° F.
Crucible 56	C 0.40; Mn 0.55; Si 1.00; Cr 3.25; Mo 2.50; V 0.33	Bars, wire, sheets, plates, and billets for reforging. Tensile strength 228,000 psi at 1000° F, 154,000 psi at 1100° F.
5CrMoV Aircraft Steel VascoJet 1000, Pyromet 882, Crucible 218, Potomac A, Dynaflex, H-11 Firedie, Unimach #1, Astro 1, Midvac H-11, Thermold A, Chromo V, Magal	C 0.40; Cr 5.00; Si 0.90; Mo 1.30; V 0.50; Fe bal	Ultrahigh strength material for use up to 1000° F.
Potomac M (Allegheny Ludlum)	C 0.40; Si 1.00; Cr 5.00; Mo 1.00; V 1.00	Similar to Potomac A.
Nu-Die V (Crucible) H-13 Vanadium Firedie (Columbia), Vulcast (Vulcan-Kidd), Cromo-High V (Bethlehem)	C 0.40; Si 1.05; Cr 5.00; Mo 1.35; V 1.10	Bars, wire, sheets, and billets for reforging.
Chro-Mow (Crucible) TCM (Vulcan-Kidd)	C 0.32; Mn 0.35; Si 1.00; Cr 5.00; Mo 1.35; W 1.35; V 0.20	Same as Crucible 218.
HTB-1 (Allegheny Ludlum)	C 1.02; Mn 0.35; Si 0.40; Cr 1.45; Al 1.00; Fe 1.00	Aircraft sheet forgings and fittings for high strength and resistance to softening up to 1000° F.
HTB-2 (Allegheny Ludlum)	C 0.58; Mn 0.30; Si 1.15; Cr 4.75; Mo 5.25; V 0.55	Used in high temperature bearing applications, primarily jet engines.
Dynacarb	C 0.12; Si 0.90; Mn 0.30; Cr 5.00; V 0.60; Mo 1.40	Low carbon version of H-11; carburizing steel for elevated temperature gear applications to 900° F.
HTB-3 (Allegheny Ludlum)	C 0.57; Mn 0.30; Si 1.15; Cr 4.75; Mo 5.25; V 0.55	Used in high temperature bearing applications, primarily jet engines.
Teton (Allegheny Ludlum)	C 1.00; Cr 1.50	For high hardness and wear resistance to 600° F. Ball and roller bearings.
HWD #1 (Firth Sterling)	C 0.35; Si 1.00; Cr 5.00; Mo 1.55; W 1.40; V 0.30	High temperature applications under 1000° F. Used mainly for structural parts requiring high strength and shock resistance.
HWD #3 (Firth Sterling)	C 0.40; Si 1.00; Cr 5.25; Mo 1.25; V 1.00	
VascoJet 1000 (5 temper)	C 0.50; Mn 0.30; Si 0.90; Cr 5.00; Mo 1.30; V 0.50	Tensile strength 300,000 to 325,000 psi.
Vasco X-4 (Vanadium Alloys)	C 0.40; Mn 0.30; Si 0.30; Cr 4.25; Co 4.25; Mo 0.40; W 4.25; V 2.10	Ultrahigh strength material.
Vasco X-8 (Vanadium Alloys)	C 0.47; Mn 0.30; Si 0.90; Cr 7.75; Mo 1.35; V 1.40	Ultrahigh strength material.
Vasco X-21 (Vanadium Alloys)	C 0.33; Mn 0.20; Si 0.30; Cr 3.50; W 9.75; V 0.45	Ultrahigh strength material.
Vasco Y-9 (Vanadium Alloys)	C 0.48; Mn 0.30; Si 0.90; Cr 3.25; Mo 1.45; V 0.25	Ultrahigh strength material.
636 Alloy	C 0.20-0.25; Mn 1.00*; Si 1.00*; Cr 12.00-14.00; Ni 0.50-1.00; Mo 0.75-1.25; W 0.75-1.25; P 0.04*; S 0.03*; V 0.20-0.50	Buckets and blades in steam turbines; aircraft valves.
No. 709 #1	C 0.30; Mn 0.55; Si 0.65; Cr 1.25; Mo 0.50; P 0.025*; S 0.025*; V 0.25	Used in aircraft, steam turbines, valves, pressure vessels; jet engine components.
No. 709 #2	C 0.45; Mn 0.55; Si 0.25; Cr 1.00; Mo 0.55; P 0.025*; S 0.025*; V 0.30	Used in aircraft, steam turbines, valves, pressure vessels; jet engine components.
D-6C; D6AC	C 0.46; Mn 0.75; Si 0.25; Cr 1.05; Ni 0.55; Mo 1.00; V 0.08 max	Ultrahigh strength steel; pressure vessels, structural parts, airframe components.
300-M	C 0.45; Mn 0.80; Si 1.60; Cr 0.80; Ni 1.80; Mo 0.40; V 0.07	Ultrahigh strength steel; pressure vessels, structural parts, airframe components.

(Continued on Page S-6)

HIGH TEMPERATURE ALLOYS (continued)

Alloy	Composition %	Properties and Applications
HS 220 (AMS 6407)	C 0.30; Mn 0.70; Si 0.60; Ni 2.05; Cr 1.20; Mo 0.45	Ultrastrength steel for aircraft uses; tensile strength to 240,000 psi.
HS 260	C 0.40; Mn 0.70; Si 0.60; Cr 1.20; Ni 2.05; Mo 0.45	Ultrastrength steel for aircraft uses; tensile strength to 280,000 psi.
Chromo-N (Bethlehem)	C 0.23; Mn 0.60; Si 1.25; Ni 0.75; Cr 10.00; Mo 1.20; V 1.00	Mandrels for extrusion, hot work applications.
Chromo W, Chromo V (Bethlehem) H-12 Alcodie (Columbia)	C 0.35; Mn 0.45; Si 0.90; Cr 5.00; W 1.25; Mo 1.45; V 0.40; Fe bal	For applications up to 1000° F requiring high strength and shock resistance.
H-13 Vanadium Firedie Smoothcut (Columbia)	C 0.38; Mn 0.45; Si 1.00; Cr 5.00; Mo 1.35; V 1.05 (with free machining additives); Fe bal	
A-9 Firedie N Smoothcut (Columbia)	C 0.51; Mn 0.45; Si 1.10; Cr 5.00; Mo 1.35; V 1.05; Ni 1.50 (with free machining additives); Fe bal	For applications up to 1000° F requiring higher strength and increased abrasion resistance. Bars, hot rolled and hammer forged; blocks, discs, and ring forgings.
H-21 Formite #2 (Columbia) 30 Calo Ferro (Vulcan-Kidd)	C 0.33; Mn 0.30; Si 0.40; Cr 3.25; W 9.50; V 0.50; Fe bal	
H-24 Formite #3 (Columbia) 50 Calo Ferro (Vulcan-Kidd)	C 0.51; Mn 0.35; Si 0.35; Cr 3.25; W 15.50; V 0.50; Fe bal	For applications up to 1000° F requiring severe abrasion resistance. Bars, hot rolled and hammer forged; blocks, discs, and ring forgings.
H-26 Clarite HW 55 (Columbia) Wolfram Low C (Vulcan-Kidd)	C 0.58; Mn 0.30; Si 0.35; Cr 4.00; W 18.00; V 0.70; Fe bal	
H-26 Clarite HW 50 (Columbia)	C 0.53; Mn 0.30; Si 0.35; Cr 4.00; W 18.00; V 1.00; Fe bal	
H-26 Clarite HW 60 (Columbia)	C 0.63; Mn 0.30; Si 0.35; Cr 4.00; W 18.00; V 1.10; Fe bal	
H-43 Molite HW 60 (Columbia)	C 0.63; Mn 0.30; Si 0.35; Cr 4.00; Mo 8.25; V 1.90; Fe bal	For applications up to 1000° F requiring severe abrasion resistance. Bars, hot rolled and hammer forged; blocks, discs, and ring forgings.
H-43 Molite HW 66 (Columbia)	C 0.68; Mn 0.30; Si 0.35; Cr 4.00; Mo 8.25; V 1.90; Fe bal	
Udimet A (Special Metal)	Ni 25.00; Ti 1.30-2.00; Al 0.30; Cb 0.50; C. 0.03*; Fe bal	High strength steel for pressure vessels and structural parts.

TYPE: NICKEL-BASE ALLOYS

Nicrotung	C 0.10; Cr 12.00; Co 10.00; W 8.00; Ti 4.00; Al 4.00; B 0.05; Zr 0.05; Ni bal	High temperature cast alloy for applications in highly stressed parts at high temperatures in the 1500-2000° F range.
Inconel Alloy 600 Raonel	C 0.04; Mn 0.20; Si 0.20; Cr 15.80; Ni 76.00; Fe 7.20	Resists oxidation up to 2150° F, carburizing and nitriding atmospheres, and corrosion. Manifolds, combustion liners, domes, transition liners.
Inconel Alloy 604	Ni 74.00; C 0.04; Mn 0.20; Fe 7.20; Si 0.20; Cr 15.80; Cb 2.00	Improved creep and rupture properties. High temperature steam; woven furnace belts.
Inconel Alloy 702	Ni 79.50; C 0.04; Mn 0.05; Fe 0.35; Si 0.20; Cr 15.60; Ti 0.70; Al 3.40	Welded aero sheet metal components; exceptional resistance to oxidation up to 2400° F.
Nimonic Alloy 75	Ni 77.60; C 0.10; Mn 0.45; Fe 0.50; Si 0.45; Cr 20.50; Ti 0.35; Al 0.20	Similar to Inconel Alloy 600. Flame tubes, afterburners.
Inconel Alloy X-750	Cb 0.85; Al 0.080; Fe 6.75; C 0.04; Mn 0.70; Si 0.30; Cr 15.00; Ni 73.00; Ti 2.50	Age-hardenable alloy. Oxidation resistance, high strength up to 1500° F. Blades, rotors, bolting, welded sheet metal components.
Inconel Alloy 751	Si 0.30; Ni 72.50; Cb 1.00; Ti 2.50; Al 1.20; Fe 6.75; C 0.04; Mn 0.70; Cr 15.00	Similar to Inconel Alloy X-750 but with increased hardener content. Turbine blades, diesel exhaust valves.
Nimonic Alloy 80A	Ni 74.50; C 0.05; Mn 0.50; Fe 0.55; Si 0.30; Cr 20.50; Ti 2.35; Al 1.25	Rotor turbine blades—up to 1400° F; stator blades.
Nimonic Alloy 90	Ni 56.20; C 0.05; Mn 0.50; Fe 0.60; Si 0.30; Cr 20.30; Ti 2.60; Al 1.65; Co 17.70	Rotor turbine blades—up to 1550° F.
Inconel Alloy 700	C 0.12; Mn 0.10; Si 0.30; Co 28.50; Mo 3.75; Al 3.00; Fe 0.70; Ti 2.20; Cr 15.00; Ni 46.00	Rotor turbine blades—up to 1650° F.
Hastelloy Alloy B (Wrought)	C 0.05*; Mn 1.00*; Si 1.00*; Cr 1.00*; Co 2.50*; Mo 28.00; Fe 5.0; V 0.40*; Ni bal	Outstanding resistance to hot hydrochloric acid, wet hydrogen chloride gas and other reducing agents. Oxidation rate in air is low enough for use up to 1400° F.
(Cast)	C 0.12*; Mn 1.00*; Si 1.00*; Cr 1.00*; Co 2.50*; Mo 28.00; Fe 5.0; V 0.60*; Ni bal	
Hastelloy Alloy C (Wrought)	C 0.08*; Mn 1.00*; Si 1.00*; Cr 15.50; Co 2.50*; Mo 16.00; W 3.75; Fe 5.50; V 0.35*; Ni bal	Good all around high temperature properties, particularly for parts highly stressed or subjected to repeated thermal shock at 1600-1800° F. Withstands strong oxidizing conditions, sea water and acetic, formic, phosphoric, sulfurous, and sulfuric acids.
(Cast)	C 0.12*; Mn 1.00*; Si 1.00*; Cr 16.50; Co 2.50*; Mo 17.00; W 4.50; Fe 5.75; V 0.40*; Ni bal	
Hastelloy Alloy R-235 (Wrought) Unitemp R235	C 0.16*; Mn 0.25*; Si 0.60*; Cr 15.00; Co 2.50*; Mo 5.00; Ti 3.00; Al 2.00; Fe 10.00; Ni bal	Vacuum melted, precipitation hardening alloy with excellent strength up to 1750° F.
GMR-235 (Cast)	C 0.20*; Mn 0.25*; Si 0.60*; Cr 15.50; Mo 5.25; Ti 2.00; Al 3.00; Fe 10.00; B 0.07; Ni bal	Has excellent stress rupture properties at high stresses up to 1700° F. Vacuum melted.
GMR-235D (Cast)	C 0.15; Mn 0.10*; Si 0.30*; Cr 15.50; Mo 5.25; Ti 2.50; Al 3.60; Fe 4.25; B 0.07; Ni bal	Investment cast. Vacuum melted. Average rupture life 160 hours, 1600°F, 28,000 psi. Applications same as GMR-235.
GMR-236	C 0.15; Cr 15.50; Ni 49.00; Mo 5.00; Ti 2.25; Al 3.25; B 0.06; Fe 25.00	
Hastelloy Alloy F	C 0.02 max; Mn 1.50; Si 1.00 max; Cb + Ta 1.75-2.50; Ta 0.50 min; Fe bal; Ni 45.50	Corrosion resistant to both acid and alkaline solutions. Used in sulfite pulp digesters for paper.
Incoloy Alloy 901; AL 901; Altemp 1251; Udimet 200 Lescalloy 901 Nickelvac 90	Mn 0.45; Si 0.40; Cr 13.50; Ni 42.70; Mo 6.20; Al 0.25; Fe 34.00; C 0.05; Ti 2.50; B 0.01-0.05	Matches mechanical properties of Inconel Alloy X-750 at temperatures to 1350° F; turbine discs and parts where high tensile, creep, and rupture strengths are needed in the 1000-1400° F range.
(Cast); Haynes 713C Alloy	C 0.20*; Mn 0.25*; Si 0.50*; Cr 13.00; Mo 4.50; Cb 2.25; Ti 0.60; Al 6.00; Fe 1.00; Ni bal	Has high rupture strength to 1700° F and above, exceptional resistance to thermal fatigue, good castability; turbine blades in advanced engines.

HIGH TEMPERATURE ALLOYS (continued)

Alloy	Composition %	Properties and Applications
Inconel Alloy 718	C 0.04; Mn 0.20; Si 0.20; Cr 19.00; Ni 52.50; Mo 3.00; Ti 0.80; Al 0.60; Cb + Ta 5.20; Fe 18.00	Age hardenable alloy with exceptionally high yield strength up to 1400° F. Weldable, corrosion resistant.
Hastelloy Alloy X (Wrought, and Cast) Unitemp HX	C 0.10; Mn 1.00*; Si 1.00*; Cr 22.00; Co 1.50; Mo 9.00; W 0.60; Fe 18.50; Ni bal	Good scale resistance to 2200° F. Excellent for cast and fabricated heat treating equipment.
(Cast)	C 0.20*; Mn 1.00*; Si 1.00*; Cr 22.00; Co 1.50; Mo 9.00; W 0.60; Fe 18.50; Ni bal	
Waspaloy; PWA 686	C 0.05; Cr 19.50; Co 13.50; Mo 4.00; Al & Ti vary with grades; Zr 0.06; B 0.005; Fe 2.00*; Ni bal	Gas turbine buckets. Largely vacuum melted.
Udimet 500; Unitemp 500 Hastelloy 500; Allvac 500	C 0.12*; Mn 0.20*; Si 0.30*; Cr 18.00; Co 18.00; Mo 4.00; Ti 3.00; Al 2.75; Fe 2.00*; Ni bal	Gas turbine components. High strength at elevated temperatures. Vacuum melted.
Thetalloy (Cast)	Mn 2.50; Cr 25.00; Co 12.50; Mo 3.00; W 7.00; Ni bal	Gas turbine diaphragms.
Udimet 700	C 0.15; Cr 17.00; Mo 4.00; Ti 4.00; Al 4.00; Co 18.00; B 0.005-0.050; Ni bal	Strong wrought alloy for applications from 1500-2000° F.
Astroloy	C 0.05; Mn 0.70*; S 0.015*; Si 0.10*; Fe 0.20*; Cr 15.0; Mo 5.0; Co 15.0; Ti 3.50; Al 4.30; B 0.03; Ni bal	Has 150,000 psi min tensile at 1400° F.
Rene 41; Haynes Alloy R41; Altemp R41; Udimet R41	C 0.09; Cr 19.00; Co 11.00; Mo 10.00; Ti 3.10; Al 1.50; B 0.005; Ni bal	High strength to 1800° F. Readily forged, formed and welded. Jet engine parts.
J-1500	C 0.15; Cr 20.00; Co 10.00; Mo 10.00; Ti 3.00; Al 1.00; Ni bal	Turbine buckets and components. High strength to 1600° F.
J-1530	C 0.08; Cr 19.50; Ni 57.00; Mo 4.30; Co 13.50; Al 1.30; Ti 3.10	Blades or high temperature parts for gas turbines.
J-1600	C 0.10; Cr 19.00; Mo 4.00; Ti 3.00; Co 19.00; Al 3.00; Ni bal	High temperature areas in jet engines, gas turbines.
M-252 (GE)	C 0.10; Mn 1.00; Si 0.70; Cr 19.00; Ni 54.00; Co 10.00; Mo 10.00; Ti 2.50; Al 0.75; B 0.005; Fe 2.00	Gas turbine buckets, torque rings. Vacuum melted.
Illium G	C 0.25; Mn 0.35; Si 0.90; Cr 22.00; Ni 58.50; Mo 6.00; Fe 6.00; Cu 6.00	High temperature and corrosion resistant applications.
Illium R	C 0.07; Mn 0.40; Si 0.11; Cr 22.00; Ni 64.00; Mo 5.00; Fe 6.00; Cu 2.50	High temperature and corrosion resistant applications.
Refractaloy 26	C 0.03; Cr 18.00; Ni 38.00; Mo 3.20; Co 20.00; Ti 2.60; Al 0.20	Jet engine and gas turbine buckets, discs, bolts, etc.
Viscotherm	Cr, Co, Al, Ti	Used in glass manufacturing. Especially suited for critical 900-1300° F operations for molds, plungers, conveyors, etc.
AF 1753 Unitemp 1753	C 0.25; Cr 16.50; W 8.50; Mo 1.50; Co 7.50; Ti 3.15; Al 2.00; B 0.008; Zr 0.05; Fe 9.50; Ni bal	High temperature alloy with good hot workability.
IN 100	C 0.18; Cr 10.00; Co 15.00; Mo 3.00; V 1.00; Al 5.50; Ti 5.00; B 0.015; Zr 0.05; Ni bal	Vacuum melted cast alloy for turbine blades and other highly stressed parts at temperatures up to 1900° F.
RA 333	C 0.08*; Mn 2.00*; Ni 45.00; Cr 25.00; W 3.50; Co 3.50; Mo 3.50; Si 1.00; Cu 0.50*; P 0.03*; S 0.03*; Pb 0.025*; Sn 0.025*	Baskets for carbonitriding furnaces, muffles, radiant tubes, retorts. Good oxidation resistance, easily fabricated.
NA-22H (Cast) (Blaw-Knox)	C 0.50; Mn 1.30; Si 1.00; Cr 27.00; Ni 48.00; W 6.00; Fe bal	Strength and oxidation resistance for use at 2200° F. Furnace muffles, fans, retorts, annealing and radiant tubes, baffle support bars, etc.
D-979 (Allegheny Ludlum)	C 0.01; Cr 14.00; Ni 45.00; Mo 4.00; W 4.00; Ti 4.00; Al 1.00; B 0.01; Fe bal	Highly stressed jet engine parts up to 1600° F. Has good workability. Allows production in all mill forms and formability in users' operations.
K-42-B	C 0.05; Cr 18.00; Ni 42.00; Co 22.00; Ti 2.00; Al 0.60; Fe bal	
DCM	C 0.05; Cr 14.30; Ni 61.00; Mo 5.30; Ti 3.40; Al 4.30; B 0.08; Fe 4.60	
Udimet 520	C 0.05; Cr 19.00; Mo 6.00; Ti 3.00; Al 2.00; Co 12.00; W 1.00; B 0.001-0.010	High temperature alloy for gas turbine buckets and discs.

TYPE: STAINLESS ALLOYS; HIGH STRENGTH IRON BASE ALLOYS

Crucible 422-M	C 0.28; Mn 0.84; Si 0.25; Cr 12.00; Ni 0.20; Mo 2.25; W 1.70; V 0.50	Alloys are higher strength modifications of AISI standard 12% chromium, Types 403 and 410 stainless. Various grades are used for steam and gas turbine buckets, compressor blades, discs, and bolts. Outstanding resistance to stress-corrosion cracking and oxidation. Available in sheets for supersonic aircraft applications.
USS 12MoV	C 0.25; Mn 0.50; Si 0.50; Ni 0.50; Cr 12.00; Mo 1.00; V 0.30	
Carpenter H-46, Midvac H46	C 0.15; Mn 0.57; Si 0.40; Cr 11.50; Mo 0.45; Cb 0.25; V 0.30	
Rex-448 (British)	C 0.15; Cr 11.50; Mo 0.45; Cb 0.45; V 0.15	
Unitemp 1409 Cb	C 0.16; Cr 12.75; Cb 0.42	
Greek Ascoloy	C 0.15; Cr 13.00; Ni 2.00; W 3.00	
Unitemp 1416 MV	C 0.15; Cr 12.25; Mo 1.00; V 0.25	
Moly Ascoloy	C 0.08; Cr 13.00; Mo 2.00	
Unitemp 1420 WM, Crucible 422, 422 Stainless, AL 422, Carpenter 636, Special Genco.	C 0.20; Cr 13.00; Ni 0.75; W 1.00; Mo 0.95; V 0.35	
Lapelloy, Linco Unitemp 1430 MV	C 0.30; Cr 11.50; Ni 0.35; Mo 2.75; V 0.25	

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HIGH TEMPERATURE ALLOYS (continued)

TYPE: Stainless Alloys; High Strength Iron Base Alloys (continued)

Alloy	Composition %	Properties and Applications
Greek Ascoloy AMS 5616 Lescolloy 5616 Unitemp 1415NW, 418 Special; Tungsten, Stainless	C 0.18; Cr 13.00; W 3.00; Ni 2.00; Fe bal	Heat resisting steel for jet engine compressor blades, turbine discs and auxiliary parts.
Lapelloy "C"	C 0.20; Mn 0.65-1.00; Si 0.50*; Cr 11.00-12.00; Ni 0.50*; Mo 2.50-3.00; P 0.03*; S 0.03*; Cu 1.75-2.25; N 0.06-0.10	Similar to Lapelloy but with greater ductility and impact strength.
AM 350, MIL-S-8840; AMS 5745; AMS 5554	C 0.09; Mn 0.75; Si 0.35; Cr 16.65; Ni 4.50; Mo 2.85; N 0.10; Fe bal	Hardenable stainless grade. High strength corrosion and heat resisting.
AM 355	C 0.13; Mn 0.75; Si 0.35; Cr 15.50; Ni 4.50; Mo 2.85; N 0.10; Fe bal	Hardenable by subzero cooling. High strength to 900° F. Compressor blading, aircraft structural members.
Armco 17-4 PH	C 0.07*; Mn 1.00; Si 1.00; Cr 16.50; Ni 4.00; Mo 0.50*; P 0.04*; S 0.03*; Cu 4.00; Cb 0.35; Fe bal	Castings for high strength, corrosion and heat resistance.
Unitemp N-155, Altemp 155 Nickelvac N155	C 0.15; Cr 21.00; Ni 20.00; Co 20.00; Mo 3.00; W 2.50; Cb + Ta 1.00; N 0.13; Fe bal	High strength to 1500° F; oxidation resistant to 1800° F. Jet engine tail pipes and afterburners, combustion chambers, nozzle assemblies, bolts, buckets, discs.
Carpenter 404	C 0.05; Mn 1.00; Si 0.50; Cr 11.00-12.50; Ni 1.25-2.00; N 0.03*	Highly stressed parts at temperatures up to 1050° F where joining is a problem.
PH 15-7 Mo (Armco)	C 0.09*; Mn 1.00*; Si 1.00*; Cr 14.00-16.00; Ni 6.50-7.50; Mo 2.00-3.00; Al 0.75-1.50; Fe bal	Hardenable by low temperature treatment to 225,000 min UTS and 200,000 psi min YS. For aircraft and missile use up to 1000° F.
Unitemp 212 (Universal Cyclops)	C 0.08; Cr 16.00; Ni 25.00; Cb + Ta 0.50; Ti 4.00; Al 0.35; Zr 0.05; B 0.06; Fe bal	Jet engine and gas turbine buckets, bolts, discs, and other components which require particularly high strengths.
Unitemp 14-14W (Universal Cyclops)	C 0.45; Cr 14.00; Ni 14.00; W 2.40; Mo 0.35	Primarily used for exhaust valves and valve seat inserts; also for other engine components subjected to elevated temperatures.
17-7 PH (Armco)	C 0.09*; Mn 1.00*; Si 1.00*; Cr 16.00-18.00; Ni 6.50-7.75; Al 0.75-1.50; Fe bal	Hardenable by low temperature heat treatment to 180,000 psi min UTS and 150,000 psi min YS. Airframes, missiles, powerplants, etc. up to 900° F.
17-5 MnV (U. S. Steel)	C 0.10; Mn 15.00; Si 0.75*; Cr 17.00; Ni 5.00; Mo 2.00; V 0.75; N 0.35 min	Room and elevated temperature mechanical properties superior to those of commonly used 18-8 type austenitic stainless. For applications requiring bar and sheet material with high strength and corrosion resistance at room or elevated temperatures.
USS Tenelon	C 0.10; Mn 15.50; Si 1.00*; N 0.35 min; Cr 18.00	Austenitic, nickel-free, stainless steel with higher strength than 18-8; corrosion resistance similar to 301 or 302 stainless.
USS 18-8 LN	C 0.03*; Mn 2.00*; Ni 10.00; Si 1.00*; N 0.10; Cr 19.00	Corrosion resistance of Type 304L but strength properties like Type 304.
RA 330	C 0.06; Ni 35.00; Cr 19.00; Si 1.25; Mn 2.00*; P 0.03*; S 0.03*; Pb 0.005*; Sn 0.025*; Cu 0.50*	Retorts, pots and fixtures for salt baths, radiant tubes, furnace belts and muffles.
USS Stainless W	C 0.10; Mn 1.00; Ni 7.00; Cr 17.00; Ti 1.00	Precipitation hardening steel with low distortion on heat treatment. Can be age hardened to room temperature tensile of 200,000 psi.
Inductovac 18-8B, Ferrovac 304 B	C 0.06; Cr 19.00; Ni 9.50; Fe 69.00; B 2.15	Atomic energy applications, such as neutron control rods.
Inductovac 18-15B	C 0.01; Mn 1.20; Cr 18.00; Ni 15.00; Fe 65.00; B 0.80	Atomic energy applications, such as neutron control rods.
19-9 DL	C 0.32; Cr 18.50; Ni 9.00; Mo 1.40; W 1.35; Cb + Ta 0.40; Ti 0.25	High temperature use in jet engine, gas turbine and turbosuperchargers as rotors, buckets, bolts, manifolds, tail cones.
19-9 DX	C 0.32; Cr 18.50; Ni 9.00; Mo 1.60; W 1.35; Ti 0.55	Cb-free alloy. Same as 19-9 DL.
Croloy 16-8-2	C 0.10; Mn 1.50; Si 0.50; Cr 15.00; Ni 8.00; Mo 1.50; Fe bal	Welding wire for TP 316 and TP 347 steels.
Crucible HNM	C 0.30; Mn 3.50; Cr 18.50; Ni 9.50; P 0.20; Fe bal	Aircraft sheet and bar applications. Compressor blades and sheets for turbine engines; nonmagnetic.
Crucible HTX	C 0.45; Mn 8.50; Cr 21.00; Ni 8.50; Mo 1.50; P 0.25; Fe bal	Turbine wheels, high temperature sheets for aircraft.
Cast HTX	C 0.45; Mn 8.00; Si 0.50; Cr 21.00; Ni 8.00; Mo 1.50; P 0.22; N 0.20; Fe bal	High strength and rupture properties up to 1600° F.
AMS 5700	C 0.45; Mn 0.70; Si 0.60; Cr 14.00; Ni 14.00; Mo 0.50; W 2.50	Good high temperature properties and resistance to corrosion in exhaust gases.
Incoloy Alloy 800	C 0.04; Mn 0.75; Si 0.35; Cr 20.50; Ni 32.50; Fe 45.50	Resistance to oxidation up to 1900° F. Similar to Inconel, but with improved resistance to attack by sulfur, green rot, molten cyanide salts; petrochemical equipment, heat treating fixtures.
Incoloy Alloy	C 0.04; Mn 0.75; Si 0.35; Cr 20.50; Ni 32.50; Ti 1.00; Fe 44.50	Slightly better elevated temperature properties. Welded sheet metal components.
Croloy 15-15N	C 0.15*; Mn 2.00*; Si 0.75*; Cr 16.00; Ni 15.00; Mo 1.55; W 1.40; Cb 1.05; N 0.15*; Fe bal	Superheater tubing, steam piping.
17-14 Cu-Mo	C 0.12; Mn 0.75; Si 0.50; Cr 15.90; Ni 14.10; Mo 2.50; Cb 0.45; Ti 0.25; Cu 3.00; Fe bal	High strength austenitic stainless steel for service up to 1500° F. Aircraft gas turbines, boilers, etc.

HIGH TEMPERATURE ALLOYS (continued)

Alloy	Composition %	Properties and Applications
Timken 16-25-6	C 0.08*; Mn 1.35; Si 0.70; Cr 16.00; Ni 25.00; Mo 6.00; N 0.15; Fe 50.00	Jet engine, gas turbine, and turbosupercharger wheels and buckets. Pickle chains. Bolting and sheet metal. Resists sea water.
Timken 16-15-6	C 0.07; Mn 7.50; Si 0.50; Cr 16.00; Ni 15.00; Mo 6.00; Fe 55.00; N 0.35	High temperature applications similar to above.
Discaloy 24	C 0.03; Mn 0.64; Si 0.92; Cr 13.10; Ni 25.50; Mo 2.83; Ti 1.83; Al 0.16; Fe bal	Turbine wheels, structural members, and fasteners in jet engine and gas turbine applications.
Uniloy 303MA	C 0.10; Mn 1.50; Si 0.50; S 0.13; Cr 18.00; Ni 9.25; Mo 0.50; Al 0.70	Free machining, faster machining, longer tool life, improved finish, improved corrosion resistance, improved resistance to splitting.
AF-71	C 0.30; Cr 12.50; Mo 3.00; Mn 18.00; B 0.20; V 0.80; N 0.20; Fe bal	Austenitic high temperature alloy.
HS-88	C 0.10; Cr 12.50; Ni 15.00; W 0.60; Mo 2.25; Ti 0.60; B 0.025; Fe bal	Austenitic high temperature alloy.
V-57; Lescalloy V-57; Altemp V-57	C 0.08*; Mn 0.25*; Si 0.55; Cr 14.75; Ni 25.50; Mo 1.25; Ti 3.00; Al 0.25; V 0.30; B 0.0075; Fe bal	High stress rupture and endurance limit; good transverse ductility. Wheels for turbojet engines, turbine cases, afterburner nozzles, aircraft fastenings.
22-4-9 (Armco)	C 0.45-0.60; Mn 7.00-10.00; Si 1.00*; Cr 20.00-23.00; Ni 3.00-5.00; N 0.30-0.50; Fe bal	Austenitic, nonmagnetic alloy with high strength and hardness up to 1600° F with good scaling resistance. Steam valves and gas turbine parts, nonmagnetic roller bearings and balls.
Gaman-H (Crucible)	C 0.65; Mn 12.00; Cr 25.00; N 0.40	Stretch and oxidation resistance for use at 2100° F.
CMN	C 0.65; Cr 24.50; Mn 12.00; N 0.40; Fe bal	Austenitic high temperature alloy.
GT-45	C 0.12; Cr 16.25; Ni 14.00; Mo 2.50; Cb 0.45; Ti 0.25; Cu 3.00; Fe bal	Austenitic high temperature alloy.
HS-27 (6059)	C 0.40; Cr 24.50; Ni 33.00; Mo 5.00; Co 32.50; Fe 2.00	Austenitic high temperature alloy.
A-286; Lescalloy A286 A 286 AL, Altemp A286 Unitemp A286	C 0.05; Mn 1.35; Si 0.95; Cr 15.00; Ni 26.00; Mo 1.75; Ti 2.00; Al 0.20; V 0.30; Fe bal	Jet engine and gas turbine wheels, bolts, discs. High strength, nonmagentic. Available in all mill product forms.
W-545	C 0.05; Mn 1.50; Si 0.40; Cr 13.50; Ni 26.00; Mo 1.50; Ti 2.85; Al 0.20; B 0.08; Fe bal	High temperature, highly stressed parts in missiles, gas turbines, steam turbines; also low temperature use in retaining rings and wedges for electrical apparatus. Nonmagnetic with high yield strength.
EME	C 0.10; Mn 0.50; Si 0.70; Cr 19.00; Ni 12.00; W 3.20; Cb 1.20; N 0.15; Fe 63.00	Steam turbine bolting and valve stems.
HS-96	C 0.10; Cr 20.00; Ni 20.00; W 2.00; Mo 3.00; Co 20.00; Fe bal	Austenitic high temperature alloy.
M-308	C 0.08; Cr 13.75; Ni 32.50; W 6.50; Mo 4.10; Ti 2.15; Al 0.30; Zr 0.25; B 0.004; Fe bal	Austenitic high temperature alloy.
Refractaloy B	C 0.07; Cr 25.00; Ni 30.00; Mo 8.00; Fe bal	Austenitic high temperature alloy.
Rex 78	C 0.10; Cr 14.00; Ni 18.00; Mo 3.50; Ti 0.75; Cu 3.50; Fe bal	Austenitic high temperature alloy.
Multimet Alloy (Wrought)	C 0.16*; Mn 1.50; Si 1.00*; Cr 21.00; Ni 20.00; Co 20.00; Mo 3.00; W 2.50; N 0.20*; Cb + Ta 1.25*; Fe bal	Good oxidation and corrosion resistance up to 2000° F. Used where good ductility is a prime factor. Jet engine tail pipes, afterburners, and nozzle assemblies.
(Cast)	C 0.20*; Mn 1.50; Si 1.00*; Cr 21.00; Ni 20.00; Co 20.00; Mo 3.00; W 2.50; N 0.20*; Cb + Ta 1.25*; Fe bal	
S-590 S590AL	C 0.40; Mn 1.50; Si 0.70; Cr 20.00; Ni 20.00; Co 20.00; Mo 4.00; W 4.00; Fe 24.00; Cb 4.00	Wheels and buckets in stationary gas turbines.
Haynes Alloy #56	C 0.27; Mn 1.5; Si 1.0; Cr 21.0; Ni 13.0; Co 11.5; Mo 4.5; W 1.5; N 0.10; Cb&Ta 0.75; Fe bal	High temperature strength and ductility for 1200 to 2000° F applications. Good corrosion and oxidation resistance.
Refractaloy 26	C 0.03; Mn 0.80; Si 1.00; Cr 18.00; Ni 38.00; Co 20.00; Mo 3.20; Ti 2.60; Al 0.20; Fe bal	Superior strength at temperatures above 1250° F. Low magnetic response, good corrosion resistance. Buckets, bolts, coiled and flat springs, turbine discs.
Refractaloy 70	C 0.04; Mn 2.00; Si 0.30; Cr 20.00; Ni 21.00; Co 30.00; Mo 8.00; W 4.20; Fe bal	Gas turbine blades and nozzle vanes. Flat and coiled springs. High endurance limit at 1200° F.
Refractaloy 80	C 0.10; Mn 0.60; Si 0.70; Cr 20.00; Ni 20.00; Co 30.00; Mo 10.00; W 5.00; Fe bal	Used extensively for creep testing holders. High strength above 1300° F.
K42B	C 0.03; Mn 0.70; Si 0.70; Cr 18.00; Ni 42.00; Co 22.00; Ti 2.10; Al 0.20; Fe bal	High resistance to heat and corrosion. Low creep up to 1350° F. Gas and steam turbine blades, bolts.
Lesco BG42	C 1.15; Si 0.30; Mn 0.50; Cr 14.50; Mo 4.00; V 1.25	Bearings, gears, cams, piston rings, valves. Heat, corrosion, and wear resistance.
J-1300 M308	C 0.08; Cr 14.00; Ni 33.00; Mo 4.00; W 6.50; Ti 2.00; Al 0.25; Zr 0.25	Austenitic grade for turbine wheels, couplings, shafts, bolts, at high temperature. Easy to forge.
G-192	C 0.60; Mn 8.50; Cr 22.00; N 0.35	Nickel-free austenitic grades developed by Allegheny Ludlum Steel Corp. for parts requiring high strength at elevated temperatures.
AF-183	C 0.30; Mn 18.00; Cr 12.00; Mo 3.00; V 0.75; N 0.20	
AF-71	C 0.30; Mn 18.00; Cr 12.00; Mo 3.00; V 0.75; N 0.30; B 0.20	

(Continued on Page S-10)

HIGH TEMPERATURE ALLOYS (continued)

TYPE: COBALT-BASE ALLOYS

Alloy	Composition %	Properties and Applications
Haynes Stellite Alloy No. 21 (Cast)	C 0.30*; Mn 1.00*; Si 1.00*; Cr 27.00; Ni 2.75; Mo 5.50; Fe 2.00*; Co bal	Resists oxidizing and reducing atmospheres up to 2100° F. Good high temperature strength, thermal shock resistant.
Haynes Stellite Alloy No. 30 (Cast)	C 0.50*; Mn 1.00*; Si 1.00*; Cr 26.00; Ni 15.00; Mo 6.00; Fe 2.00*; Co bal	Excellent creep properties at 1600° F. Modulus of elasticity does not drop off rapidly and endurance properties are good.
Haynes Stellite Alloy No. 31 (Cast) AMS 5382B (X-40) PWA 651	C 0.55*; Mn 1.00*; Si 1.00*; Cr 25.50; Ni 10.50; W 7.50; Fe 2.00*; Co bal	Good endurance and creep properties. Stress-rupture strength 27,000 psi at 1500° F for 100 hours.
Haynes Alloy No. 36 (Cast)	C 0.45*; Mn 1.50*; Si 1.00*; Cr 18.50; Ni 10.00; W 15.00; Fe 2.00*; B 0.05*; Co bal	Cast modification of Alloy No. 25. Excellent creep and rupture properties. Good ductility.
Haynes Alloy No. 25 (Wrought); WF-11 (Crucible); Unitemp L-605; Altemp L-605	C 0.15*; Mn 1.50; Si 1.00*; Cr 20.00; Ni 10.00; W 15.00; Fe 3.00*; Co bal	Exceptional high temperature strength. Good forming and welding characteristics. Used for nozzle partitions, afterburner assemblies.
J-1570	C 0.20; Cr 20.00; Ni 28.00; W 6.00; Ti 4.00; Co bal	Gas turbine buckets and high temperature sheet metal parts. Vacuum melted. Can be forged and welded.
S-816 (Allegheny Ludlum); Altemp S-816 (AMS 5765A)	C 0.38; Mn 1.50; Si 0.70; Cr 20.00; Ni 20.00; Co 43.00; Mo 4.00; W 4.00; Cb 4.00; Fe 3.00	Jet engine buckets. High temperature springs. Steam turbine bolting and buckets.
V-36 (Allegheny Ludlum)	C 0.31; Mn 0.90; Si 0.50; Cr 25.00; Ni 20.00; Co 42.00; Mo 4.00; W 2.00; Cb 2.20; Fe 3.00	Sheet uses over 1600° F requiring high tensile, rupture, and creep strengths.
Nivco	C 0.02; Mn 0.35; Si 0.15; Ni 22.50; Co 73.50; Ti 1.80; Al 0.22; Fe 0.30; P 0.005; S 0.009; Zr 1.10	High damping material with good high temperature strength for applications to 1200° F. Applications include low noise gearing. Precipitron wires, nonvibratory tool supports, and compressor blades.
Haynes Alloy No. 151 (Cast)	C 0.48; Mn 1.00*; Si 1.00*; Cr 20.00; W 12.75; Fe 2.0*; Ni 1.0*; Ti 0.28; B 0.05; Co bal	For integrally cast turbine wheels operating at 1200-1600° F. For stationary turbine vanes operating at 1700-1800° F.
J-1650	C 0.20; B 0.02; Ni 27.00; Cr 19.00; Ta 2.00; W 12.00; Ti 3.80; Co bal	One of strongest wrought alloys commercially available.
WI-52 PWA 653A	Cr 21.00; W 11.00; C 0.45; Mn 0.50*; Si 0.50*; Ni 1.00*; Fe 0.60*; P 0.040*; S 0.040*; Cb + Ta 1.75	Provides an average rupture life of 73 hours and rupture elongation of 17% when tested at 1800° F.
Jetalloy 209	C 0.02; Cr 20.00; Ni 10.00; W 15.00; Co 50.00; Ti 2.00; Fe 1.00	High temperature resistance for jet engine parts.

*Indicates Maximum.

STAINLESS AND HEAT-RESISTANT STEELS

AISI No.	C	Mn Max	Si Max	Cr	Ni	P Max	S Max	Properties and Applications
201	0.15 max	5.5–7.50 Other: N 0.25 max	1.00	16–18	3.5–5.5	0.060	0.030	Low-nickel alternate for 301; somewhat higher strength than 301. General applications similar to 301.
202	0.15 max	7.5–10.00 Other: N 0.25 max	1.00	17–19	4–6	0.060	0.030	Low-nickel alternate for 302; somewhat higher strength than 302. General applications similar to 302.
301	0.15 max	2.00	1.00	16–18	6–8	0.045	0.030	Rapid work hardening. Railroad cars, trailer bodies, aircraft structurals.
302	0.15 max	2.00	1.00	17–19	8–10	0.045	0.030	General purpose, chromium nickel type. Trim, food handling equipment, jewelry, aircraft cowling, antennas, springs, architectural, cookware.
302B	0.15 max	2.00	2.0–3.0	17–19	8–10	0.045	0.030	Higher scaling resistance at elevated temperatures than 302. Furnace parts, still liners, heating elements.
303	0.15 max	2.00 Other: Mo 0.60 max‡	1.00	17–19	8–10	0.20	0.15 min	Free machining; lower galling and seizing tendency than 302. Screw machine products, shafts, valves.
303Se	0.15 max	2.00 Other: Se 0.15 min	1.00	17–19	8–10	0.20	0.06	Better transverse properties, lower machinability, better finish than 303; improved workability.
304†	0.08 max	2.00	1.00	18–20	8–12	0.045	0.030	General purpose alloy for welding. Chemical and food processing equipment, recording wire.
304L	0.03 max	2.00	1.00	18–20	8–12	0.045	0.030	Weldments for corrosive conditions where intergranular carbide precipitation must be avoided. Atomic energy applications.
305	0.12 max	2.00	1.00	17–19	10–13	0.045	0.030	Low work-hardening rate. Maximum plasticity for forming, spinning, cold heading.
308	0.08 max	2.00	1.00	19–21	10–12	0.045	0.030	Welding rods and electrodes.
309	0.20 max	2.00	1.00	22–24	12–15	0.045	0.030	High scale resistance, good strength at high temperatures. Aircraft heaters, heat treating equipment, annealing covers, furnace parts.
309S	0.08 max	2.00	1.00	22–24	12–15	0.045	0.030	Weldments with high scale resistance.
310	0.25 max	2.00	1.50	24–26	19–22	0.045	0.030	Like 309 but even higher heat resistance. Excellent for general use. Heat exchangers, furnace parts, combustion chambers, welding rods.
310S	0.08 max	2.00	1.50	24–26	19–22	0.045	0.030	Like 309S but has even higher heat resistance.
314	0.25 max	2.00	1.5–3.0	23–26	19–22	0.045	0.030	Highest heat resistance. Uses similar to 310. Resistant to carburizing. Heat treating fixtures.
316†	0.08 max	2.00 Other: Mo 2.00–3.00	1.00	16–18	10–14	0.045	0.030	Higher resistance to corrosives affecting other stainless steels. High creep resistance. High temperature parts, chemical and pulp handling equipment, photographic and food equipment.

STAINLESS AND HEAT RESISTANT STEELS (continued)

AISI No.	C	Mn Max	Si Max	Cr	Ni	P Max	S Max	Properties and Applications
316L	0.03 max	2.00	1.00	16–18	10–14	0.045	0.030	Version of 316 for weldments where intergranular carbide precipitation must be avoided. Permits stress relief at 1550–1650° F.
	Other: Mo 2.00–3.00							
317	0.08 max	2.00	1.00	18–20	11–15	0.045	0.030	Higher in corrosion resistance than 316.
	Other: Mo 3.00–4.00							
D319	0.07 max	2.00	1.00	17.5–19.5	11–15	0.045	0.030	Modification of 316. Slightly superior to 316 for chemical service.
321†	0.08 max	2.00	1.00	17–19	9–12	0.045	0.030	For weldments subject to severely corrosive conditions and service in 800–1650° F range. Aircraft exhaust manifolds, boiler shells, expansion joints, process equipment.
	Other: Ti 5xC min							
347†	0.08 max	2.00	1.00	17–19	9–13	0.045	0.030	For uses similar to 321. More widely used for welded process equipment.
	Other: Cb-Ta 10xC min							
348†	0.08 max	2.00	1.00	17–19	9–13	0.045	0.030	Equivalent to 347. For atomic energy applications due to low retentivity.
	Other: Cb-Ta 10xC min, Ta 0.10 max; Co 0.20 max							
403*	0.15 max	1.00	0.50	11.5–13	.....	0.040	0.030	Steam turbine blades, jet engine compressor blades, highly stressed parts.
405	0.08 max	1.00	1.00	11.5–14.5	.....	0.040	0.030	Nonhardenable. For welded assemblies where air-hardening of 410 or 403 is objectionable.
	Other: Al 0.10–0.30							
410*	0.15 max	1.00	1.00	11.5–13.5	.....	0.040	0.030	General purpose corrosion and heat resistance. Hardenable by heat treatment. Coal screens, low priced cutlery, machine parts, valve trim.
414*	0.15 max	1.00	1.00	11.5–13.5	1.25–2.50	0.040	0.030	High-strength version of 410. Rules and straight edges, mild springs, scraper knives.
416*	0.15 max	1.25	1.00	12–14	.....	0.06	0.15 min	Free machining. Bolts, nuts, screws, carburetor parts, fishing reels, golf club heads, instrument parts, screw machine parts, valve trim.
	Other: Mo 0.60 max‡							
416Se*	0.15 max	1.25	1.00	12–14	.....	0.06	0.06	Higher transverse properties, better finish, lower machinability than 416; improved workability.
	Other: Se 0.15 min							
420*	Over 0.15	1.00	1.00	12–14	.....	0.040	0.030	High hardness from heat treatment. General purpose cutlery grade. Surgical instruments.
430	0.12 max	1.00	1.00	14–18	.....	0.040	0.030	General purpose, nonhardenable chromium type. Decorative trim, nitric acid tanks, annealing baskets, auto trim, sinks.
430F	0.12 max	1.25	1.00	14–18	.....	0.06	0.15 min	Free-machining bars. Screw machine parts, screws and other fasteners.
	Other: Mo 0.60 max‡							
430FSe	0.12 max	1.25	1.00	14–18	.....	0.06	0.06	Free machining, retaining forgeability. Fine finish quality. Similar to 430F.
	Other: Se 0.15 min							
431*	0.20 max	1.00	1.00	15–17	1.25–2.50	0.040	0.030	Special purpose hardenable type. Aircraft fittings, bolts, paper machinery, windshield wiper arms, beater bars, springs.
440A*	0.60–0.75	1.00	1.00	16–18	.....	0.040	0.030	High strength and corrosion resistance. Hardenable by heat treatment. Toughest high chrome cutlery grade, bearings, seaming rolls, surgical tools.
	Other: Mo 0.75 max							
440B*	0.75–0.95	1.00	1.00	16–18	.....	0.040	0.030	Cutlery grade. Uses similar to 440A.
	Other: Mo 0.75 max							
440C*	0.95–1.20	1.00	1.00	16–18	.....	0.040	0.030	Ball bearing grade. Also bushings, valve parts, cutlery.
	Other: Mo 0.75 max							
446	0.20 max	1.50	1.00	23–27	.....	0.040	0.030	Resistance to high-temperature scaling, hot sulfur-bearing gases and oxidizing acids.
	Other: N 0.25 max							
501*	Over 0.10	1.00	1.00	4–6	.....	0.040	0.030	Moderate resistance to scaling but limited corrosion resistance. Oil industry equipment—stills, heat exchangers, hot lines.
	Other: Mo 0.40–0.65							
502*	0.10 max	1.00	1.00	4–6	.....	0.040	0.030	Uses similar to 501.
	Other: Mo 0.40–0.65							

‡At producer's option; reported only when intentionally added.

*Respond to heat treatment to develop a wide range of mechanical properties.

†ASTM grades with prefix "TP," suffix "H" (for heat treated) used at temperatures over 1000° F. ASTM specification A 213-60T.

Source: American Iron & Steel Institute, 1961.

CAST HIGH ALLOYS — Corrosion & Heat Resistant

ACI Designation	Equiv. (Wrought)	Nominal Composition %	Outstanding Properties and Typical Uses
CA-15	410	C 0.15 max; Mn 1.00 max; Si 1.50 max; Cr 11.5-14.0; Ni 1.0 max; Mo 0.5 max*; Fe bal	Hardenability, 144 to 400 BHN. Good atmospheric corrosion resistance. Pump casings, bushings and liners, impellers, shafts, turbine blades, stuffing boxes, valve bodies and trim, fittings, furnace burner tips, and pilot cones.
CA-40	420	C 0.20-0.40; Mn 1.00 max; Si 1.50 max; Cr 11.5-14.0; Ni 1.0 max; Mo 0.5 max*; Fe bal	Hardenability, up to 500 BHN. Corrosion resistance same as CA-15. Choppers, cutting blades, cylinder liners, pump parts, steam turbine parts, molds, dies.
CB-30	431	C 0.30 max; Mn 1.00 max; Si 1.00 max; Cr 18-22; Ni 2.0; Fe bal	Resists nitric acid, alkali, and many organic chemicals. Good machinability. Furnace brackets and hangers, pump parts, rabble arms, tube supports, valve bodies and parts.
CC-50	446	C 0.50 max; Mn 1.00 max; Si 1.00 max; Cr 26-30; Ni 4.0 max; Fe bal	Magnetic, good machinability; resists dilute sulfuric acid, mixed nitric and sulfuric acids, and oxidizing acids. Bushings, cylinder liners, pump casings and impellers, valve bodies and seats.
CD-4MCu	...	C 0.040 max; Mn 1.00 max; Si 1.00 max; Cr 25-27; Ni 4.75-6.00; Mo 1.75-2.25; Cu 2.75-3.25; Fe bal	High strength, precipitation hardening alloy with corrosion resistance equal to CF-8. Hardenability, 290 to 320 Brinell. Valve trim, pumps, fittings, high pressure parts, gears.
CE-30	312	C 0.30 max; Mn 1.50 max; Si 2.00 max; Cr 26-30; Ni 8-11; Fe bal	Better strength and ductility than CC-50; useful where castings cannot be heat treated. Resists sulfurous acid and sulfites. Process industry equipment such as digester fittings, fractionating towers, pipings, pump bodies and casings, valve bodies and parts.

(Continued on Page S-12)

CAST HIGH ALLOYS (continued)

ACI Designation	Equiv. (Wrought)	Nominal Composition %	Outstanding Properties and Typical Uses
CF-3	304L	C 0.03 max; Mn 1.50 max; Si 2.00 max; Cr 17-21; Ni 8-12; Fe bal	Lower carbon modification of CF-8. Useful where castings cannot be heat treated after welding.
CF-8	304	C 0.08 max; Mn 1.50 max; Si 2.00 max; Cr 18-21; Ni 8-11; Fe bal	High impact strength at low temperatures. Resists strong oxidants such as boiling nitric acid. Autoclaves, blast furnace bushings, filter press plates, hardware, headers and heating coils, pump parts, spray nozzles, valve parts.
CF-20	302	C 0.20 max; Mn 1.50 max; Si 2.00 max; Cr 18-21; Ni 8-11; Fe bal	High ductility and impact strength. Satisfactory in many oxidizing environments. Cylinder liners, pumps, return bends, rolls, circuit breaker parts, valve parts.
CF-3M	316L	C 0.03 max; Mn 1.50 max; Si 1.50 max; Cr 17-21; Ni 9-13; Mo 2.0-3.0; Fe bal	Lower carbon modification of CF-8M. Useful where castings cannot be heat treated after welding.
CF-8M	316	C 0.08 max; Mn 1.50 max; Si 2.00 max; Cr 18-21; Ni 9-12; Mo 2.0-3.0; Fe bal	Used up to 1000° F—ductile and strong. Resists reducing solutions and pitting corrosion in sea water. Agitators, evaporator parts, jet engine components, spray nozzles, high pressure steam valves.
CF-12M	316	C 0.12 max; Mn 1.50 max; Si 2.00 max; Cr 18-21; Ni 9-12; Mo 2.0-3.0; Fe bal	Preferred over CF-8M for operating temperatures above 1200° F; corrosion resistance not quite as good as CF-8M. Agitators, evaporator parts, jet engine components, spray nozzles, high pressure steam valves.
CF-8C	347	C 0.08 max; Mn 1.50 max; Si 2.00 max; Cr 18-21; Ni 9-12; Cb 8 x C min, 1.0 max or Cb + Ta 10 x C min, 1.35 max; Fe bal	Suitable for field welding. Corrosion resistance similar to CF-8. Aircraft shroud assemblies, autoclaves, chemical tubing, fittings, jet engine parts, marine fittings.
CF-16F	303	C 0.16 max; Mn 1.50 max; Si 2.00 max; Cr 18-21; Ni 9-12; Se 0.20-0.35; Mo 1.50 max; P 0.17 max; Fe bal	Improved machinability, good welding characteristics. Corrosion resistance inferior to CF-20, but adequate for many purposes. Bearings, bushings, fittings, pump and machinery parts.
CG-8M	317	C 0.08 max; Mn 1.50 max; Si 1.50 max; Cr 18-21; Ni 9-13; Mo 3.0-4.0; Fe bal	Properties similar to CF-8M, but preferred in reducing environments. Especially useful for applications in the pulp and paper industry.
CH-20	309	C 0.20 max; Mn 1.50 max; Si 2.00 max; Cr 22-26; Ni 12-15; Fe bal	More ductile than CE-30 but not as strong; stronger than CF-8 but not as ductile. Resists hot dilute sulfuric acid. Digester fittings, roasting equipment, valves.
CK-20	310	C 0.20 max; Mn 1.50 max; Si 2.00 max; Cr 23-27; Ni 19-22; Fe bal	Withstands elevated temperatures, resists dilute sulfuric acid. Digesters, filter press parts, fittings, jet engine parts, pumps, valves.
CN-7M	...	C 0.07 max; Mn 1.50 max; Si 1.50 max; Cr 19-22; Ni 27.5-30.5; Mo 1.75-2.50; Cu 3.00 min; Fe bal	Good machining and fair welding properties, nonmagnetic. Resists: Sulfuric acid, reducing chemicals, dilute hydrochloric acid, hot chlorides and nitric acid. Filter parts, heat exchanger parts, pickling rolls, hooks, and racks.
HA	...	C 0.20 max; Mn 0.35-0.65; Si 1.00 max; Mo 0.90-1.20; Cr 8-10; Fe bal	Maximum use temperature: 1300° F. Fan blades for hot gases, trunnions for glass rolls.
HC	446	C 0.50 max; Mn 1.00 max; Si 2.00 max; Mo 0.5 max*; Cr 26-30; Ni 4 max; Fe bal	Maximum use temperature: 1200° F with moderately heavy loading; 1900° F with light loading. Used in sulfur atmosphere when heavy loading is not involved; in ore roasting furnaces for rabble arms and blades.
HD	327	C 0.50 max; Mn 1.50 max; Si 2.00 max; Mo 0.5 max*; Cr 26-30; Ni 4-7; Fe bal	Properties and uses same as Type HC with greater strength at elevated temperatures. Useful in sulfur atmospheres. Ore roasting furnace parts, salt pots, grate bars.
HE	312	C 0.20-0.50; Mn 2.00 max; Si 2.00 max; Mo 0.5 max*; Cr 26-30; Ni 8-11; Fe bal	Maximum use temperature: 2000° F. Good corrosion resistance and ductility; moderate strength at elevated temperatures. Stands sulfur atmospheres.
HF	302B	C 0.20-0.40; Mn 2.00 max; Si 2.00 max; Mo 0.5 max*; Cr 19-23; Ni 9-12; Fe bal	Maximum use temperature: 1600° F. Good corrosion resistance in the range 1200-1600° F. Oil refineries for tube supports and beams; cement mill parts, ore roasting furnace parts, heat treating furnaces.
HH	309	C 0.20-0.50; Mn 2.00 max; Si 2.00 max; Mo 0.5 max*; N 0.2 max; Cr 24-28; Ni 11-14; Fe bal	Maximum use temperature: 2000° F. High strength and oxidation resistance at elevated temperatures. Depending on composition, the alloy can be partially ferritic or fully austenitic. Tube supports and beams in oil refineries, ore roasting furnace parts, and heat treating parts.
HI	...	C 0.20-0.50; Mn 2.00 max; Si 2.00 max; Mo 0.5 max*; Cr 26-30; Ni 14-18; Fe bal	Maximum use temperature: 2150° F. Cast retorts for magnesium production.
HK	310	C 0.20-0.60; Mn 2.00 max; Si 2.00 max; Mo 0.5 max*; Cr 24-28; Ni 18-22; Fe bal	Maximum use temperature: 2100° F. Resists hot gas corrosion better than Type HH. Not recommended where severe thermal shock is involved. High creep strength alloy for jet engines, gas turbines, furnace parts.
HL	...	C 0.20-0.60; Mn 2.00 max; Si 2.00 max; Mo 0.5 max*; Cr 28-32; Ni 18-22; Fe bal	Maximum use temperature: 1800° F. Good corrosion resistance in sulfur atmospheres. Gas dissociation equipment, fixtures.
HN	...	C 0.20-0.50; Mn 2.00 max; Si 2.00 max; Mo 0.5 max*; Cr 19-23; Ni 23-27; Fe bal	Good high temperature strength and corrosion resistance in chemically reactive media. Brazing fixtures for use up to 2060° F.
HT	330	C 0.35-0.75; Mn 2.00 max; Si 2.50 max; Mo 0.5 max*; Cr 13-17; Ni 33-37; Fe bal	Maximum use temperature: 2100° F in oxidizing and 2000° F in reducing atmospheres. Excellent service life where subject to rapid heating and cooling. Heat treating furnace parts such as rails, rolls, discs, chains, boxes, pots, and fixtures subject to cyclic heating. Also used for glass rolls, enameling racks.
HU	...	C 0.35-0.75; Mn 2.00 max; Si 2.50 max; Mo 0.5 max*; Cr 17-21; Ni 37-41; Fe bal	Strength and corrosion resistance at high temperatures; similar to HT. Used where improved resistance to hot gas corrosion is required.
HW	...	C 0.35-0.75; Mn 2.00 max; Si 2.50 max; Mo 0.5 max*; Cr 10-14; Ni 58-62; Fe bal	Maximum use temperature: 2050° F in oxidizing, 1900° F in reducing atmospheres. Excellent for severe service at high temperatures involving cyclic heating or thermal shock. Hearths, muffles, retorts, trays, boxes, burner parts, enameling fixtures, quenching fixtures, molten lead containers.
HX	...	Cr 0.35-0.75; Mn 2.00 max; Si 2.50 max; Mo 0.5 max*; Cr 15-19; Ni 64-68; Fe bal	Maximum use temperatures same as HW, but better in resistance to reducing gases containing sulfur at 1800° F. Used in contact with tempering and cyaniding salts. Same applications as HW, improved resistance to hot gas corrosion.

NOTES:

*Molybdenum is not intentionally added to these compositions.

1. Sulfur does not exceed 0.04 per cent in any composition. Except for Type CF-16F, phosphorus does not exceed 0.04 per cent in any composition.
2. Most of the standard grades listed are covered for general applications by American Society for Testing Materials specifications A 296-60T and A 297-60T. ASTM specifications A 217-60T, A 351-60T, A 362-52T, B 190-50 and B 207-50 also apply to some of the grades.
3. Cast alloy chemical composition ranges *are not the same* as the wrought alloys. Buyers should use cast alloy designations for proper identification of castings.

Source: Alloy Casting Institute, 1961.

FERROUS CASTINGS

DUCTILE (Nodular or Spheroidal Graphite) IRON

Specification	Class or Grade	Tensile Min (psi)	Yield Min (psi)	Elong. in 2 in. (min %)	Heat Treatment	Properties and Typical Applications
ASTM A339-55	80-60-03	80,000	60,000	3	.....	High strength in as-cast condition. Heavy duty machinery, gears, dies, rolls.
	60-45-10	60,000	45,000	10	Usually annealed	Toughness and machinability. Pressure castings, valves, pump bodies, compressor heads, shock resisting parts.
Mil-1-17166A (ships)	60-40-15	60,000	40,000	15	Ferritized by annealing to 190 max BHN	Navy shipboard and other uses requiring shock resistance. Motor frames, ends, engine blocks, heads, compressors, valves, clamps.
ASTM A396-58	120-90-02	120,000	90,000	2	Heat treated	For high strength applications (obtained by heat treatment), pinions, gears, cams, guides, track rollers.
	100-70-03	100,000	70,000	3		
Mil-1-11466 (ordnance)	Class 1	120,000	90,000	2	Usually quenched and tempered	Military equipment.
	Class 2	100,000	75,000	4		
	Class 3	85,000	60,000	6		
	Class 4	80,000	60,000	3	As-cast	(Unless otherwise specified, one metallographic test shall be made for each lot.)
	Class 5	60,000	45,000	10	Ferritized by annealing	
	Class 6	60,000	40,000	18		

Source: Gray Iron Founders' Society Inc.

MALLEABLE IRON

Spec. No.	Grade No.	Tensile* Min (psi)	Yield* Min (psi)	Elong. in 2 in. (min %)	Properties and Typical Applications
		FERRITIC			
ASTM A-47-52	32510	50,000	32,500	10	Tough, impact and fatigue resistant, easily machined, uniform structure. Castable in ⅛-in. minimum sections. Automobile, truck differential cases, carriers, steering gear housings, brackets, railroad car and track parts, agricultural implement parts, conveyor and electrical fittings.
	35018	53,000	35,000	18	
	58000	65,000†	40,000–45,000†	15–20†	Corrosion resistant parts needing high strength and good machinability.
		PEARLITIC			
ASTM A-220-55T	45010	65,000	45,000	10	High strength, hardness, resistance to abrasion, good machinability. Has castability and excellent surface finish of standard malleable. Hardenable to 50-60 Rc. Automotive valve rocker arms, automatic transmission parts, agricultural implement gears, sprockets, crankshafts, weapon parts, diesel electric power switch segment gears, armature and frame heads, gear cases, shifter forks.
	45007	68,000	45,000	7	
	48004	70,000	48,000	4	
	50007	75,000	50,000	7	
	53004	80,000	53,000	4	
	60003	80,000	60,000	3	
	80002	100,000	80,000	2	
SAE	43010	60,000	43,000	10	These specifications cover pearlitic, malleable iron castings for railroad, motor vehicle, marine, agricultural, and general machinery purposes, including localized hardening applications.
	48005	70,000	48,000	5	
	53004	80,000	53,000	4	
	60003	80,000	60,000	3	
	70002	90,000	70,000	2	

Source: Malleable Founders' Society.

*Higher tensile and yield strengths may be obtained from any of the pearlitic malleable grades by a conventional quench-and-temper treatment.

†Typical values.

CAST STEEL—Carbon Structural Grades

ASTM or SAE Specifications	Class	Tensile Strength (psi)	Yield Strength (psi)	Elong. (%)	Carbon (max %)	Manganese (max %)	Properties and Typical Applications
A-27-58	N-1	.....	.....	..	0.25	0.75	
	N-2	.....	.....	..	0.35	0.60	Low electrical resistivity, excellent weldability. Can be carburized and case hardened. Electrical equipment gears, drums, railroad and furnace equipment.
	N-3	.....	.....	..	...	1.00	
	U-60-30	60,000	30,000	22	0.25	0.75	
	60-30	60,000	30,000	24	0.30	0.60	
	65-30	65,000	30,000	20	...	...	Excellent weldability, medium strength, good durability and machinability. Railroad, power shovel, rolling mill equipment, presses, gears, sprockets, machine frames, miscellaneous medium strength castings.
	65-35	65,000	35,000	24	0.30	0.70	
	70-36	70,000	36,000	22	0.35	0.70	
	70-40	70,000	40,000	22	0.25	1.20	
SAE	0022	.....	.....	..	0.22	0.90	
Automotive	0030	65,000	35,000	24	0.30	0.70	High strength, toughness, good fatigue, wear resistance, high rigidity. Gears, rolls, blanking and forming dies, pinions, sprockets, machine tools, impellers, liners, castings requiring rigidity and hardness.
Steel Castings	0050	85,000	45,000	16	0.50	0.90	
	0050	100,000	70,000	10	0.50	0.90	
	080	80,000	40,000	18	...	...	

Grades 090, 0105, 0120, 0150, 0175 have corresponding tensile strength, no analysis specification.

CAST STEEL—Low Alloy Engineering Grades

ASTM or SAE Specifications	Class	Tensile Strength (psi)	Yield Strength (psi)	Elong. (%)	Properties and Typical Applications
A-148-58	80-40	80,000	40,000	18	Excellent weldability, medium strength, high toughness, good machinability, shock and abrasion resistant.
SAE 090	80-50	80,000	50,000	22	Pneumatic tools, railroad equipment, pressure parts, automotive parts, track wheels, tractor treads, gears, sprockets.

(Continued on Page S-14)

FERROUS CASTINGS (continued)

Cast Steel—Low Alloy Engineering Grades (continued)

ASTM or SAE Specifications	Class	Tensile Strength (psi)	Yield Strength (psi)	Elong. (%)	Carbon (max %)	Manganese (max %)	Properties and Typical Applications
A-148-58 SAE 090	90-60	90,000	60,000	20			Offers a variety of strengths and hardenabilities depending on alloy content. Good fatigue properties. Normalized and tempered: Oil well tools, sheaves, sprockets, locomotive parts; gears, cams, earth moving equipment, highly stressed parts. Quenched and tempered: Gears, cams, rollers, bucket teeth, small crusher jaws, conveyor chain links, dredge pumps, impellers, valve liners, oil field tongs. Good impact properties.
SAE 0105 SAE 0120	105-85 120-95	105,000 120,000	85,000 95,000	17 14			High resistance to impact, excellent strength and toughness. Normalized and tempered: Excellent air hardening properties. Abrasion resistant applications, dredge pumps, gears, dies, rolling mill equipment, shock valves, flanges, turbine casings, hydroelectric equipment. Quenched and tempered: Good low temperature impact toughness, excellent abrasion resistance, deep hardening.
SAE 0150 SAE 0175	150-125 175-145	150,000 175,000	125,000 145,000	9 6			Deep hardening, high strength, and wear resistance.

CAST STEEL—High and Low Temperature Service

ASTM or SAE Specifications	Class	Tensile Strength (psi)	Yield Strength (psi)	Elong. (%)	Bend and Impact Properties	Properties and Typical Applications
A-216-59T	WCA	60,000	30,000	24	90 degree bend*	A-216-59T carbon steels exhibit good weldability and good creep resistance at relatively high temperatures. Pressure containing castings for medium high temperature service.
	WCB	70,000	36,000	22	90 degree bend*	
A-217-59T	WC1	65,000	35,000	24	90 degree bend	A-217-59T steels are alloyed to give good creep resistance and high temperature properties. Pressure containing castings for high temperature service.
	WC4, WC5	70,000	40,000	20	90 degree bend	
	WC6, WC9					
	C5, C12	90,000	60,000	18	90 degree bend	
A-352-59T	LCB, LC1	65,000	35,000	24	15 ft-lb**	Ferritic steels with good notch ductility at temperatures from —50 to —150° F. Test temperatures for each grade: —50° F, LCB; —75° F, LC1; —100° F, LC2; —150° F, LC3. Pressure containing castings for service at low temperatures.
	LC2, LC3	65,000	40,000	24	15 ft-lb**	
A-356-58T	1	70,000	36,000	20	.....	Heavy walled ferritic carbon and low alloy castings for steam turbines. Wall thicknesses over 1 in. Cylinders, valve chests, throttle valves and similar castings.
	2	65,000	35,000	22	.....	
	3	80,000	50,000	18	.....	
	4	90,000	60,000	16	.....	
	5	70,000	40,000	22	.....	
	6	70,000	45,000	22	.....	
	7	70,000	40,000	22	.....	
	8	80,000	50,000	18	.....	
	9	95,000	60,000	15	.....	
	10	85,000	55,000	20	.....	

*Expected value only, no test required unless specified.

**Charpy keyhole notch impact test required at temperatures specified by customer.
Source: Steel Founders' Society of America.

GRAY IRON

Specification		Class	Tensile Min (psi)	Heat Treatment*	Properties and Typical Applications
ASTM* A-48-60T* ASA G25.1-1961 ASME S61-1948 AASHO M105-49 CSA S61-1948 Federal QQ-1-652a*	All basically the same	20 25	20,000 25,000	2	General use when maximum machinability and damping capacity are desired, and moderate strength is adequate.
		30 35	30,000 35,000	1	Good mechanical properties with high machinability. Most commonly used grade for general machinery, valves, light compressor bodies, municipal castings, waterworks equipment.
		40 45	40,000 45,000	1	Machine tools, medium gear blanks, heavy compressors, motor blocks.
		50 60	50,000 60,000	1	Large castings for heavy service: Dies, hydraulic cylinders, machine tools, permanent molds, large gears, press frames.

*Requires one tensile test for each lot (size of lot is specified).

Specification		Class	Tensile Min (psi)	Heat Treatment*	Properties and Typical Applications
ASTM A159-55	Automotive castings	110	20,000	2	Miscellaneous soft iron castings in which strength and microstructure are not primary considerations.
SAE spec. No. given in class column		111	30,000	1	Small cylinder blocks, heads, pistons, clutch plates, oil pump bodies, gearboxes, clutch housings, lightweight brake drums.
		113	30,000	1	Brake drums and clutch plates for moderate service requirements where high-carbon iron is desired and heat checking is problem.
		114	40,000	1	Heavy duty drums and clutch plates where strength and resistance to heat checking are requirements.
		120	35,000	1	Automotive cylinder blocks, heads, flywheels, cylinder liners, pistons.
		121	40,000	1	Truck and tractor cylinder blocks, heads, heavy flywheels, tractor transmission cases, differential carriers.
		122	45,000	1	Diesel engine castings, liners, cylinders, pistons, heavy parts.

FERROUS CASTINGS (continued)

Gray Iron (continued)

Specification	Class	Tensile Min (psi)	Heat Treatment*	Properties and Typical Applications
ASTM A278-56	40	40,000	3	Pressure containing parts for use up to 650° F. Valve bodies, paper mill dryer rolls, chemical process equipment.
	50	50,000	3	
	60	60,000	3	
ASTM A319-53	I	Low	2	Nonpressure containing parts for elevated temperature. Stoker and firebox parts, grate bars, process furnace parts, ingot molds. I: Superior resistance to thermal shock. II: Average resistance to thermal shock; moderate tensile strength. III: High creep and rupture strength.
	II	30,000	2	
	III	about 40,000	2	
U.S. Navy 46-1-9	..	25,000	..	High alloy scale resisting castings. For resistance to corrosion of acid, caustic and salt, including concentrated brine.
Mil-G-858A	I	25,000	..	High alloy for resistance to corrosion, scaling, warpage, growth; use at elevated temperatures. Galley range tops; to resist acid, caustic, and salt.
	II	25,000	..	

Source: Gray Iron Founders' Society Inc.
*1. Hardenable by conventional, flame, or induction heat treatment. 2. Hardening not recommended. 3. Must be stress relief annealed.

ALLOY STEELS

Standard, Tentative Standard (TS) & Boron Open Hearth & Electric Furnace Steel—Bars, Billets, Blooms, Slabs

SAE or AISI Number	C	Mn	P Max	S Max	Si	Ni	Cr	Mo
1330	0.28–0.33	1.60–1.90	0.040	0.040	0.20–0.35	.....	.....	.....
1335	0.33–0.38	1.60–1.90	0.040	0.040	0.20–0.35	.....	.....	.....
1340	0.38–0.43	1.60–1.90	0.040	0.040	0.20–0.35	.....	.....	.....
1345	0.43–0.48	1.60–1.90	0.040	0.040	0.20–0.35	.....	.....	.....
TS 14B35*	0.33–0.38	0.75–1.00	....	....	0.20–0.35	.....	.....	.....
3140	0.38–0.43	0.70–0.90	0.040	0.040	0.20–0.35	1.10–1.40	0.55–0.75	.....
E3310**	0.08–0.13	0.45–0.60	0.025	0.025	0.20–0.35	3.25–3.75	1.40–1.75	.....
4012	0.09–0.14	0.75–1.00	0.040	0.040	0.20–0.35	.....	.....	0.15–0.25
4023	0.20–0.25	0.70–0.90	0.040	0.040	0.20–0.35	.....	.....	0.20–0.30
4024	0.20–0.25	0.70–0.90	0.040	0.035–0.050	0.20–0.25	.....	.....	0.20–0.30
4027	0.25–0.30	0.70–0.90	0.040	0.040	0.20–0.35	.....	.....	0.20–0.30
4028	0.25–0.30	0.70–0.90	0.040	0.035–0.050	0.20–0.35	.....	.....	0.20–0.30
4037	0.35–0.40	0.70–0.90	0.040	0.040	0.20–0.35	.....	.....	0.20–0.30
4042	0.40–0.45	0.70–0.90	0.040	0.040	0.20–0.35	.....	.....	0.20–0.30
4047	0.45–0.50	0.70–0.90	0.040	0.040	0.20–0.35	.....	.....	0.20–0.30
4063	0.60–0.67	0.75–1.00	0.040	0.040	0.20–0.35	.....	.....	0.20–0.30
4118	0.18–0.23	0.70–0.90	0.040	0.040	0.20–0.35	.....	0.40–0.60	0.08–0.15
4130	0.28–0.33	0.40–0.60	0.040	0.040	0.20–0.35	.....	0.80–1.10	0.15–0.25
4135	0.33–0.38	0.70–0.90	0.040	0.040	0.20–0.35	.....	0.80–1.10	0.15–0.25
4137	0.35–0.40	0.70–0.90	0.040	0.040	0.20–0.35	.....	0.80–1.10	0.15–0.25
4140	0.38–0.43	0.75–1.00	0.040	0.040	0.20–0.35	.....	0.80–1.10	0.15–0.25
TS 4140*	0.38–0.43	0.80–1.05	....	....	0.20–0.35	.....	0.90–1.20	0.08–0.15
4142	0.40–0.45	0.75–1.00	0.040	0.040	0.20–0.35	.....	0.80–1.10	0.15–0.25
4145	0.43–0.48	0.75–1.00	0.040	0.040	0.20–0.35	.....	0.80–1.10	0.15–0.25
4147	0.45–0.50	0.75–1.00	0.040	0.040	0.20–0.35	.....	0.80–1.10	0.15–0.25
4150	0.48–0.53	0.75–1.00	0.040	0.040	0.20–0.35	.....	0.80–1.10	0.15–0.25
TS 4150*	0.48–0.53	0.80–1.05	....	....	0.20–0.35	.....	0.90–1.20	0.08–0.15
4320	0.17–0.22	0.45–0.65	0.040	0.040	0.20–0.35	1.65–2.00	0.40–0.60	0.20–0.30
4337	0.35–0.40	0.60–0.80	0.040	0.040	0.20–0.35	1.65–2.00	0.70–0.90	0.20–0.30
E4337*	0.35–0.40	0.65–0.85	0.025	0.025	0.20–0.35	1.65–2.00	0.70–0.90	0.20–0.30
4340	0.38–0.43	0.60–0.80	0.040	0.040	0.20–0.35	1.65–2.00	0.70–0.90	0.20–0.30
E4340	0.38–0.43	0.65–0.85	0.025	0.025	0.20–0.35	1.65–2.00	0.70–0.90	0.20–0.30
4422	0.20–0.25	0.70–0.90	0.040	0.040	0.20–0.35	.....	.....	0.35–0.45
4427	0.24–0.29	0.70–0.90	0.040	0.040	0.20–0.35	.....	.....	0.35–0.45
4520	0.18–0.23	0.45–0.65	0.040	0.040	0.20–0.35	.....	.....	0.45–0.60
4615	0.13–0.18	0.45–0.65	0.040	0.040	0.20–0.35	1.65–2.00	.....	0.20–0.30
4617	0.15–0.20	0.45–0.65	0.040	0.040	0.20–0.35	1.65–2.00	.....	0.20–0.30
4620	0.17–0.22	0.45–0.65	0.040	0.040	0.20–0.35	1.65–2.00	.....	0.20–0.30
4621	0.18–0.23	0.70–0.90	0.040	0.040	0.20–0.35	1.65–2.00	.....	0.20–0.30
4718	0.16–0.21	0.70–0.90	0.040	0.040	0.20–0.35	0.90–1.20	0.35–0.55	0.30–0.40
4720	0.17–0.22	0.50–0.90	0.040	0.040	0.20–0.35	0.90–1.20	0.35–0.55	0.15–0.25
4815	0.13–0.18	0.40–0.60	0.040	0.040	0.20–0.35	3.25–3.75	.....	0.20–0.30
4817	0.15–0.20	0.40–0.60	0.040	0.040	0.20–0.35	3.25–3.75	.....	0.20–0.30
4820	0.18–0.23	0.50–0.70	0.040	0.040	0.20–0.35	3.25–3.75	.....	0.20–0.30
5015	0.12–0.17	0.30–0.50	0.040	0.040	0.20–0.35	.....	0.30–0.50	.....
50B40	0.38–0.43	0.75–1.00	0.040	0.040	0.20–0.35	.....	0.40–0.60	.....
50B44	0.43–0.48	0.75–1.00	0.040	0.040	0.20–0.35	.....	0.40–0.60	.....
5046	0.43–0.50	0.75–1.00	0.040	0.040	0.20–0.35	.....	0.20–0.35	.....
50B46	0.43–0.50	0.75–1.00	0.040	0.040	0.20–0.35	.....	0.20–0.35	.....
50B50	0.48–0.53	0.75–1.00	0.040	0.040	0.20–0.35	.....	0.40–0.60	.....
50B60	0.55–0.65	0.75–1.00	0.040	0.040	0.20–0.35	.....	0.40–0.60	.....
5115	0.13–0.18	0.70–0.90	0.040	0.040	0.20–0.35	.....	0.70–0.90	.....
5120	0.17–0.22	0.70–0.90	0.040	0.040	0.20–0.35	.....	0.70–0.90	.....
5130	0.28–0.33	0.70–0.90	0.040	0.040	0.20–0.35	.....	0.80–1.10	.....
5132	0.30–0.35	0.60–0.80	0.040	0.040	0.20–0.35	.....	0.75–1.00	.....
5135	0.33–0.38	0.60–0.80	0.040	0.040	0.20–0.35	.....	0.80–1.05	.....
5140	0.38–0.43	0.70–0.90	0.040	0.040	0.20–0.35	.....	0.70–0.90	.....
5145	0.43–0.48	0.70–0.90	0.040	0.040	0.20–0.35	.....	0.70–0.90	.....
5147	0.45–0.52	0.70–0.95	0.040	0.040	0.20–0.35	.....	0.85–1.15	.....
5150	0.48–0.53	0.70–0.90	0.040	0.040	0.20–0.35	.....	0.70–0.90	.....
5155	0.50–0.60	0.70–0.90	0.040	0.040	0.20–0.35	.....	0.70–0.90	.....
5160	0.55–0.65	0.75–1.00	0.040	0.040	0.20–0.35	.....	0.70–0.90	.....
51B60	0.55–0.65	0.75–1.00	0.040	0.040	0.20–0.35	.....	0.70–0.90	.....
E50100**	0.95–1.10	0.25–0.45	0.025	0.025	0.20–0.35	.....	0.40–0.60	.....
E51100**	0.95–1.10	0.25–0.45	0.025	0.025	0.20–0.35	.....	0.90–1.15	.....
E52100**	0.95–1.10	0.25–0.45	0.025	0.025	0.20–0.35	.....	1.30–1.60	.....
								V
6118	0.16–0.21	0.50–0.70	0.040	0.040	0.20–0.35	.....	0.50–0.70	0.10–0.15
6120	0.17–0.22	0.70–0.90	0.040	0.040	0.20–0.35	.....	0.70–0.90	0.10 min
6150	0.48–0.53	0.70–0.90	0.040	0.040	0.20–0.35	.....	0.80–1.10	0.15 min

(Continued on Page S-16)

ALLOY STEELS (continued)

SAE or AISI Number	C	Mn	P Max	S Max	Si	Ni	Cr	Mo
8115	0.13–0.18	0.70–0.90	0.040	0.040	0.20–0.35	0.20–0.40	0.30–0.50	0.08–0.15
81B45	0.43–0.48	0.75–1.00	0.040	0.040	0.20–0.35	0.20–0.40	0.35–0.55	0.08–0.15
8615	0.13–0.18	0.70–0.90	0.040	0.040	0.20–0.35	0.40–0.70	0.40–0.60	0.15–0.25
8617	0.15–0.20	0.70–0.90	0.040	0.040	0.20–0.35	0.40–0.70	0.40–0.60	0.15–0.25
8620	0.18–0.23	0.70–0.90	0.040	0.040	0.20–0.35	0.40–0.70	0.40–0.60	0.15–0.25
8622	0.20–0.25	0.70–0.90	0.040	0.040	0.20–0.35	0.40–0.70	0.40–0.60	0.15–0.25
8625	0.23–0.28	0.70–0.90	0.040	0.040	0.20–0.35	0.40–0.70	0.40–0.60	0.15–0.25
8627	0.25–0.30	0.70–0.90	0.040	0.040	0.20–0.35	0.40–0.70	0.40–0.60	0.15–0.25
8630	0.28–0.33	0.70–0.90	0.040	0.040	0.20–0.35	0.40–0.70	0.40–0.60	0.15–0.25
8637	0.35–0.40	0.75–1.00	0.040	0.040	0.20–0.35	0.40–0.70	0.40–0.60	0.15–0.25
8640	0.38–0.43	0.75–1.00	0.040	0.040	0.20–0.35	0.40–0.70	0.40–0.60	0.15–0.25
8642	0.40–0.45	0.75–1.00	0.040	0.040	0.20–0.35	0.40–0.70	0.40–0.60	0.15–0.25
8645	0.43–0.48	0.75–1.00	0.040	0.040	0.20–0.35	0.40–0.70	0.40–0.60	0.15–0.25
86B45	0.43–0.48	0.75–1.00	0.040	0.040	0.20–0.35	0.40–0.70	0.40–0.60	0.15–0.25
8650	0.48–0.53	0.75–1.00	0.040	0.040	0.20–0.35	0.40–0.70	0.40–0.60	0.15–0.25
8655	0.50–0.60	0.75–1.00	0.040	0.040	0.20–0.35	0.40–0.70	0.40–0.60	0.15–0.25
8660	0.55–0.65	0.75–1.00	0.040	0.040	0.20–0.35	0.40–0.70	0.40–0.60	0.15–0.25
8720	0.18–0.23	0.70–0.90	0.040	0.040	0.20–0.35	0.40–0.70	0.40–0.60	0.20–0.30
8735*	0.33–0.38	0.75–1.00	0.040	0.040	0.20–0.35	0.40–0.70	0.40–0.60	0.20–0.30
8740	0.38–0.43	0.75–1.00	0.040	0.040	0.20–0.35	0.40–0.70	0.40–0.60	0.20–0.30
8742	0.40–0.45	0.75–1.00	0.040	0.040	0.20–0.35	0.40–0.70	0.40–0.60	0.20–0.30
8822	0.20–0.25	0.75–1.00	0.040	0.040	0.20–0.35	0.40–0.70	0.40–0.60	0.30–0.40
9255	0.50–0.60	0.70–0.95	0.040	0.040	1.80–2.20	.....	.....	.....
9260	0.55–0.65	0.70–1.00	0.040	0.040	1.80–2.20	.....	.....	.....
9262	0.55–0.65	0.75–1.00	0.040	0.040	1.80–2.20	.....	0.25–0.40	.....
E9310**	0.08–0.13	0.45–0.65	0.025	0.025	0.20–0.35	3.00–3.50	1.00–1.40	0.08–0.15
94B15	0.13–0.18	0.75–1.00	0.040	0.040	0.20–0.35	0.30–0.60	0.30–0.50	0.08–0.15
94B17	0.15–0.20	0.75–1.00	0.040	0.040	0.20–0.35	0.30–0.60	0.30–0.50	0.08–0.15
94B30	0.28–0.33	0.75–1.00	0.040	0.040	0.20–0.35	0.30–0.60	0.30–0.50	0.08–0.15
94B40	0.38–0.43	0.75–1.00	0.040	0.040	0.20–0.35	0.30–0.60	0.30–0.50	0.08–0.15
9840	0.38–0.43	0.70–0.90	0.040	0.040	0.20–0.35	0.85–1.15	0.70–0.90	0.20–0.30
9850	0.48–0.53	0.70–0.90	0.040	0.040	0.20–0.35	0.85–1.15	0.70–0.90	0.20–0.30
Standard Nitriding Steel	0.38–0.43	0.50–0.70	0.040	0.040	0.20–0.40	Al 0.95–1.30	1.40–1.80	0.30–0.40

Source—American Iron & Steel Institute, 1961.

NOTES

1. TS denotes tentative standard steels.
2. Boron steels indicated by B can be expected to have 0.0005 per cent minimum boron content.
3. Grades with prefix E are manufactured by basic electric furnace process. All others are normally produced by basic open hearth process but may be made by basic electric furnace process with adjustments in phosphorus and sulfur.
4. Ranges and limits apply to steel not exceeding 200 sq in. cross-sectional area.
5. All chemical ranges and limits are subject to standard variations for check analysis over or under specification.

*No corresponding SAE number.
**SAE numbers do not have prefix E.

6. Phosphorus and sulfur limitations for each process:

Basic electric furnace	0.025% max
Basic open hearth	0.040% max
Acid electric furnace	0.050% max
Acid open hearth	0.050% max

7. Minimum silicon limit for acid open hearth or acid electric furnace alloy steel is 0.15 per cent.
8. Small quantities of certain elements in alloy steel are not specified or required. They are considered as incidental and may be present in these maximum amounts: Copper, 0.35%; nickel, 0.25; chromium, 0.20; molybdenum, 0.06.
9. Where sulfur content range is shown, it is indicative of resulfurized steel.

H-STEELS — Standard, Tentative Standard (TS) & Boron Open Hearth & Electric Furnace Steels—Bars, Billets, Blooms

SAE or AISI NUMBER	C	Mn	Si	Ni	Cr	Mo
1330–H	0.27–0.33	1.45–2.05	0.20–0.35	.....	.....	.....
1335–H	0.32–0.38	1.45–2.05	0.20–0.35	.....	.....	.....
1340–H	0.37–0.44	1.45–2.05	0.20–0.35	.....	.....	.....
TS 14B35–H	0.32–0.38	0.65–1.10	0.20–0.35	.....	.....	.....
3140–H	0.37–0.44	0.60–1.00	0.20–0.35	1.00–1.45	0.45–0.85	.....
3310–H	0.07–0.13	0.30–0.70	0.20–0.35	3.20–3.80	1.30–1.80	.....
4027–H	0.24–0.30	0.60–1.00	0.20–0.35	.....	.....	0.20–0.30
4028–H*	0.24–0.30	0.60–1.00	0.20–0.35	.....	.....	0.20–0.30
4037–H	0.34–0.41	0.60–1.00	0.20–0.35	.....	.....	0.20–0.30
4042–H	0.39–0.46	0.60–1.00	0.20–0.35	.....	.....	0.20–0.30
4047–H	0.44–0.51	0.60–1.00	0.20–0.35	.....	.....	0.20–0.30
4063–H	0.59–0.69	0.65–1.10	0.20–0.35	.....	.....	0.20–0.30
4118–H	0.17–0.23	0.60–1.00	0.20–0.35	.....	0.30–0.70	0.08–0.15
4130–H	0.27–0.33	0.30–0.70	0.20–0.35	.....	0.75–1.20	0.15–0.25
4135–H	0.32–0.38	0.60–1.00	0.20–0.35	.....	0.75–1.20	0.15–0.25
4137–H	0.34–0.41	0.60–1.00	0.20–0.35	.....	0.75–1.20	0.15–0.25
4140–H	0.37–0.44	0.65–1.10	0.20–0.35	.....	0.75–1.20	0.15–0.25
TS 4140–H	0.37–0.44	0.70–1.20	0.20–0.35	.....	0.85–1.30	0.08–0.15
4142–H	0.39–0.46	0.65–1.10	0.20–0.35	.....	0.75–1.20	0.15–0.25
4145–H	0.42–0.49	0.65–1.10	0.20–0.35	.....	0.75–1.20	0.15–0.25

H STEELS (continued)

SAE or AISI NUMBER	C	Mn	Si	Ni	Cr	Mo
4147–H	0.44–0.51	0.65–1.10	0.20–0.35	.....	0.75–1.20	0.15–0.25
4150–H	0.47–0.54	0.65–1.10	0.20–0.35	.....	0.75–1.20	0.15–0.25
TS 4150–H	0.47–0.54	0.70–1.20	0.20–0.35	.....	0.85–1.30	0.08–0.15
4320–H	0.17–0.23	0.40–0.70	0.20–0.35	1.55–2.00	0.35–0.65	0.20–0.30
4337–H	0.34–0.41	0.55–0.90	0.20–0.35	1.55–2.00	0.65–0.95	0.20–0.30
4340–H	0.37–0.44	0.55–0.90	0.20–0.35	1.55–2.00	0.65–0.95	0.20–0.30
4520–H	0.17–0.23	0.35–0.75	0.20–0.35	.....	.....	0.45–0.60
E4340–H	0.37–0.44	0.60–0.95	0.20–0.35	1.55–2.00	0.65–0.95	0.20–0.30
4620–H	0.17–0.23	0.35–0.75	0.20–0.35	1.55–2.00	.....	0.20–0.30
4621–H	0.17–0.23	0.60–1.00	0.20–0.35	1.55–2.00	.....	0.20–0.30
4718–H	0.15–0.21	0.60–0.95	0.20–0.35	0.85–1.25	0.30–0.60	0.30–0.40
4720–H	0.17–0.23	0.45–0.75	0.20–0.35	0.85–1.25	0.30–0.60	0.15–0.25
4815–H	0.12–0.18	0.30–0.70	0.20–0.35	3.20–3.80	.....	0.20–0.30
4817–H	0.14–0.20	0.30–0.70	0.20–0.35	3.20–3.80	.....	0.20–0.30
4820–H	0.17–0.23	0.40–0.80	0.20–0.35	3.20–3.80	.....	0.20–0.30
5046–H	0.43–0.50	0.65–1.10	0.20–0.35	.....	0.13–0.43	.....
50B40–H	0.37–0.44	0.65–1.10	0.20–0.35	.....	0.30–0.70	.....
50B44–H	0.42–0.49	0.65–1.10	0.20–0.35	.....	0.30–0.70	.....
50B46–H	0.43–0.50	0.65–1.10	0.20–0.35	.....	0.13–0.43	.....
50B50–H	0.47–0.54	0.65–1.10	0.20–0.35	.....	0.30–0.70	.....
50B60–H	0.55–0.65	0.65–1.10	0.20–0.35	.....	0.30–0.70	.....
5120–H	0.17–0.23	0.60–1.00	0.20–0.35	.....	0.60–1.00	.....
5130–H	0.27–0.33	0.60–1.00	0.20–0.35	.....	0.75–1.20	.....
5132–H	0.29–0.35	0.50–0.90	0.20–0.35	.....	0.65–1.10	.....
5135–H	0.32–0.38	0.50–0.90	0.20–0.35	.....	0.70–1.15	.....
5140–H	0.37–0.44	0.60–1.00	0.20–0.35	.....	0.60–1.00	.....
5145–H	0.42–0.49	0.60–1.00	0.20–0.35	.....	0.60–1.00	.....
5147–H	0.45–0.52	0.60–1.05	0.20–0.35	.....	0.80–1.25	.....
5150–H	0.47–0.54	0.60–1.00	0.20–0.35	.....	0.60–1.00	.....
5155–H	0.50–0.60	0.60–1.00	0.20–0.35	.....	0.60–1.00	.....
5160–H	0.55–0.65	0.65–1.10	0.20–0.35	.....	0.60–1.00	.....
51B60–H	0.55–0.65	0.65–1.10	0.20–0.35	.....	0.60–1.00	V
6118–H	0.15–0.21	0.40–0.80	0.20–0.35	.....	0.40–0.80	0.10–0.15
6120–H	0.17–0.23	0.60–1.00	0.20–0.35	.....	0.60–1.00	0.10 min
6150–H	0.47–0.54	0.60–1.00	0.20–0.35	.....	0.75–1.20	0.15 min
						Mo
81B45–H	0.42–0.49	0.70–1.05	0.20–0.35	0.15–0.45	0.30–0.60	0.08–0.15
8617–H	0.14–0.20	0.60–0.95	0.20–0.35	0.35–0.75	0.35–0.65	0.15–0.25
8620–H	0.17–0.23	0.60–0.95	0.20–0.35	0.35–0.75	0.35–0.65	0.15–0.25
8622–H	0.19–0.25	0.60–0.95	0.20–0.35	0.35–0.75	0.35–0.65	0.15–0.25
8625–H	0.22–0.28	0.60–0.95	0.20–0.35	0.35–0.75	0.35–0.65	0.15–0.25
8627–H	0.24–0.30	0.60–0.95	0.20–0.35	0.35–0.75	0.35–0.65	0.15–0.25
8630–H	0.27–0.33	0.60–0.95	0.20–0.35	0.35–0.75	0.35–0.65	0.15–0.25
8637–H	0.34–0.41	0.70–1.05	0.20–0.35	0.35–0.75	0.35–0.65	0.15–0.25
8640–H	0.37–0.44	0.70–1.05	0.20–0.35	0.35–0.75	0.35–0.65	0.15–0.25
8642–H	0.39–0.46	0.70–1.05	0.20–0.35	0.35–0.75	0.35–0.65	0.15–0.25
8645–H	0.42–0.49	0.70–1.05	0.20–0.35	0.35–0.75	0.35–0.65	0.15–0.25
86B45–H	0.42–0.49	0.70–1.05	0.20–0.35	0.35–0.75	0.35–0.65	0.15–0.25
8650–H	0.47–0.54	0.70–1.05	0.20–0.35	0.35–0.75	0.35–0.65	0.15–0.25
8655–H	0.50–0.60	0.70–1.05	0.20–0.35	0.35–0.75	0.35–0.65	0.15–0.25
8660–H	0.55–0.65	0.70–1.05	0.20–0.35	0.35–0.75	0.35–0.65	0.15–0.25
8720–H	0.17–0.23	0.60–0.95	0.20–0.35	0.35–0.75	0.35–0.65	0.20–0.30
8740–H	0.37–0.44	0.70–1.05	0.20–0.35	0.35–0.75	0.35–0.65	0.20–0.30
8742–H	0.39–0.46	0.70–1.05	0.20–0.35	0.35–0.75	0.35–0.65	0.20–0.30
8822–H	0.19–0.25	0.70–1.05	0.20–0.35	0.35–0.75	0.35–0.65	0.30–0.40
9260–H	0.55–0.65	0.65–1.10	1.70–2.20	.....	.....	.....
9262–H	0.55–0.65	0.65–1.10	1.70–2.20	.....	0.20–0.50	.....
9310–H	0.07–0.13	0.40–0.70	0.20–0.35	2.95–3.55	1.00–1.45	0.08–0.15
94B15–H	0.12–0.18	0.70–1.05	0.20–0.35	0.25–0.65	0.25–0.55	0.08–0.15
94B17–H	0.14–0.20	0.70–1.05	0.20–0.35	0.25–0.65	0.25–0.55	0.08–0.15
94B30–H	0.27–0.33	0.70–1.05	0.20–0.35	0.25–0.65	0.25–0.55	0.08–0.15
94B40–H	0.37–0.44	0.70–1.05	0.20–0.35	0.25–0.65	0.25–0.55	0.08–0.15
9840–H	0.37–0.44	0.60–0.95	0.20–0.35	0.80–1.20	0.65–0.95	0.20–0.30
9850–H	0.47–0.54	0.60–0.95	0.20–0.35	0.80–1.20	0.65–0.95	0.20–0.30

NOTES
1. TS denotes tentative standard steels.
2. Boron steels indicated by B can be expected to have 0.0005% min boron content.
3. Notes 4, 5, 6, 7, and 8 on Alloy Steels apply to H-Steels.

Source: American Iron & Steel Institute, 1961.
*Sulfur content 0.035-0.050%.

SPRING ALLOYS

Name or Trademark and Specification	Nominal Composition, %*	Properties and Typical Uses
HIGH CARBON WIRE		
Music Wire ASTM A228-51 AMS-5112	C 0.70-1.00; Mn 0.20-0.60	Widely used for small springs. High tensile strength; stands high stresses. Temperature limit: 250° F. Torsion working stress 90,000-180,000 psi; bending working stress 150,000-350,000 psi.
MB Grade Oil Tempered ASTM A229-56	C 0.55-0.75; Mn 0.60-1.20	General purpose steel for coil springs where high performance of music wire is not needed, or in larger sizes than available in music wire. Not recommended for cyclic, impact loading, or use above 350° F. Torsion working stress 80,000-130,000 psi; bending working stress 120,000-250,000 psi.
MB Grade Hard Drawn ASTM A227-47	C 0.45-0.75; Mn 0.60-1.20	Cheapest spring steel for general purposes. Used where accuracy of loads and deflections not important. Temperature limit: 250° F. Torsion working stress 75,000-130,000 psi; bending working stress 100,000-200,000 psi.
MB Grade Soft or Untempered	C 0.55-0.75; Mn 0.60-1.20	Used in helical springs or wire forms where severe forming is required. May be obtained dead soft (annealed at final size) or with one or more draws after heat treatment. Hardened and tempered after fabrication.
HB Grade Soft, Hard Drawn, or Oil Tempered	C 0.71-0.85; Mn 0.60-0.90	Uses similar to MB grade. Tensile strengths higher than MB grade, but in the hard drawn condition are lower than music wire. Uses are about halfway between the two.
Extra HB Grade Soft or Oil Tempered	C 0.86-1.05; Mn 0.30-0.60	Applications same as HB grade; tensile values 10,000 psi higher.
Upholstery Grade ASTM A407-57T ASTM A417-57T	C 0.45-0.70; Mn 0.60-1.20 C 0.50-0.75; Mn 0.60-1.20	Not suitable for mechanical springs. Intended specifically for use in manufacture of upholstery. Spring constructions such as mattress springs, bed springs, furniture, and zigzag automobile seat springs.

SPRING ALLOYS (continued)

Name or Trademark and Specification	Nominal Composition %*	Properties and Typical Uses
FLAT HIGH CARBON		
Cold Rolled Flat Spring Steel, Hard Rolled or Annealed SAE 1050	C 0.48-0.65; Mn 0.60-0.90	Used for miscellaneous springs and washers. In annealed condition will withstand more severe deformation than the 0.65-0.80 carbon grade.
Cold Rolled Spring Steel, Tempered or Annealed AISI 1075	C 0.65-0.80; Mn 0.30-0.90	Most popular flat, cold rolled spring steel. Used for spring clips, flat springs, spiral springs.
Cold Rolled Spring Steel, Tempered or Annealed SAE 1095	C 0.90-1.05; Mn 0.30-0.50	Used principally for clock and motor springs. Can withstand higher stress than the 0.65-0.80 carbon grade. Used for instrument and flat springs that have limited forming requirements.
ALLOY STEELS		
Chromium AISI 5155 SAE 5155	C 0.50-0.60; Mn 0.70-0.90; Si 0.20-0.35; Cr 0.70-0.90	Automotive type leaf springs.
Chromium AISI 5160 SAE 5160	C 0.55-0.65; Mn 0.75-1.00; Si 0.20-0.35; Cr 0.70-0.90	Automotive type coil springs.
Chrome-Vanadium ASTM A60-49	C 0.48-0.53; Mn 0.70-0.90; Cr 0.80-1.10; Si 0.20-0.35; V 0.15 min	Hot rolled, chromium-vanadium steel bars used in the manufacture of springs.
Chrome-Vanadium ASTM A231-41 SAE 6150	C 0.45-0.55; Mn 0.60-0.90; Cr 0.80-1.10; Si 0.15-0.30; V 0.15 (0.18 desired)	Good for shock, impact loading, and temperatures to 425° F. Torsion working stress 100,000-130,000 psi; bending working stress 180,000-230,000 psi.
Silicon-Manganese ASTM A59-49 SAE 9260	C 0.55-0.65; Mn 0.70-1.00; Si 1.80-2.20	Used in flat leaf springs for trucks and as a substitute for more expensive steels. Not recommended in pretempered wire.
Chrome-Silicon ASTM A401-58 SAE 9254	C 0.50-0.60; Mn 0.50-0.80; Si 1.20-1.60; Cr 0.50-0.80	For highly stressed springs requiring long life that are subject to shock loading, such as recoil springs on guns. Can be heat treated to Rc 50-53. May be used up to 475° F. Torsion working stress 115,000-150,000 psi; bending working stress 190,000-240,000 psi.
Chrome-Moly-Nickel AISI 8650 ASTM A332-56 Grade 8650	C 0.48-0.53; Mn 0.75-1.00; Si 0.20-0.35; Ni 0.40-0.70; Cr 0.40-0.60; Mo 0.15-0.25	Developed as an alternate for chrome-vanadium SAE 6150. Used in large sections for hot formed springs in railroad cars.
Chrome-Moly-Nickel AISI 8655 ASTM A332-56 Grade 8655	C 0.50-0.60; Mn 0.75-1.00; Si 0.20-0.35; Ni 0.40-0.70; Cr 0.40-0.60; Mo 0.15-0.25	Uses same as for AISI 8650.
Chrome-Moly-Nickel AISI 8660 ASTM A332-56 Grade 8660	C 0.55-0.65; Mn 0.75-1.00; Si 0.20-0.35; Cr 0.40-0.60; Ni 0.40-0.70; Mo 0.15-0.25	Uses same as for AISI 8650.
VALVE SPRING WIRE		
High Carbon Valve Spring Wire ASTM A230-47	C 0.60-0.75; Mn 0.50-0.80; Si 0.12-0.30	Valve springs in automotive and aircraft engines and other springs requiring high fatigue properties. Uniform properties, smooth finish, and tensile strengths of 195,000-250,000 psi.
Chrome-Vanadium Valve Spring Wire ASTM A232-47 AMS-6450	C 0.45-0.55; Mn 0.60-0.90; Si 0.12-0.30; Cr 0.80-1.10; V 0.15-0.25	Automotive and aircraft valve springs. Stands high stresses, shock and impact loading up to 400° F, with long fatigue life.
STAINLESS STEELS		
AISI 301 and 302	Ni 7.00-10.00; Cr 17.00-19.00; C 0.15 max	Furnished in reasonably high tensile strength with lower permeability than carbon steels. Magnetic when worked to spring temper. General purpose corrosion resistance uses. Can be used to 550° F. Torsion working stress 45,000-140,000 psi; bending working stress 60,000-260,000 psi.
AISI 316	Ni 10.00-14.00; Cr 16.00-18.00; Mo 2.00-3.00; Mn 2.00; C 0.08 max	Addition of Mo increases corrosion resistance to most chemicals, particularly the halogens. Lower tensile than 302 for similar amounts of cold reduction. Torsion working stress 40,000-120,000 psi; bending working stress 55,000-220,000 psi.
17-7 PH (Armco) AMS 5673A	Ni 7.00; Cr 17.00; C 0.07; Al 1.00	Good corrosion resistance. Can be used up to 700° F. Torsion working stress 134,000-160,000 psi; bending working stress 195,000-225,000 psi.
PH 15-7 Mo (Armco)	Ni 7.00; Cr 15.00; Mo 2.25; C 0.066; Al 1.10	Similar to 17-7PH. (Armco). Useful to 800° F.
AISI 410, 420, 440	Cr 12.00-18.00	Only used for springs in the heat treated condition. Hardened after forming. Not corrosion resistant unless polished.
AM 350	C 0.09; Mn 0.75; Si 0.35; Cr 16.65; Ni 4.50; Mo 2.85; N 0.10	Excellent stability under long time service up to 900° F.
AM 355 NS 355	C 0.13; Mn 0.75; Si 0.35; Cr 15.50; Ni 4.50; Mo 2.85; N 0.10	Harden before or after forming. Higher strength than AM 350.
COPPER-BASE ALLOYS		
Electrolytic Tough Pitch	Cu 99.90	110 — Has best electrical conductivity of copper and copper-base alloys supplied in spring temper. Used in radio parts and electrical switches.
Gilding, 95%	Cu 95.00; Zn 5.00	210 — Rolled strip supplied in spring temper.
Commercial Bronze, 90%	Cu 90.00; Zn 5.00	220 — Flat products and wire supplied in spring temper. Tensile strength increases and conductivity is slightly reduced with lower copper content.
Jewelry Bronze, 87.50%	Cu 87.50; Zn 12.50	226
Red Brass, 85%	Cu 85.00; Zn 15.00	230
Low Brass, 80%	Cu 80.00; Zn 20.00	240
Cartridge Brass, 70% ASTM B134-52 SAE 80A	Cu 70.00; Zn 30.00	260 — A hard-drawn material usually used in the spring-hard temper. Inexpensive, high electrical conductivity, low tensile strength. Used in flat stampings where sharp bends are needed.
Yellow Brass; ASTM B134-52	Cu 65.00; Zn 35.00	268 — Flat products and wire supplied in spring temper. Low strength springs.
Phosphor Bronze, 5% (A)	Cu 94.00; Sn 3.50-5.80; P 0.03-0.35	510 — Combines good strength, hardness, electrical conductivity, and corrosion resistance with low cost. Used for contact fingers in switches.
Phosphor Bronze, 8% (C)	Cu 92.00; Sn 7.00-9.00; P 0.03-0.35	521 — Used for more severe service than the 5% alloy. Typical usse: Cotter pins, diaphragms, fuse clips, switch parts, wire brushes.
Phosphor Bronze, 10% (D)	Cu 90.00; Sn 9.00-11.00; P 0.03-0.35	524 — Heavy bars and plates for severe compression, good wear, and corrosion resistance. Used for parts requiring extra spring qualities, greater resiliency, particularly in fatigue.
Nickel Silver, 55-18	Cu 55.00; Ni 18.00; Zn 27.00	770 — The nickel silver alloys have a silvery white color that harmonizes with surroundings. Used for contact fingers. Good electrical conductivity, corrosion resistance.
Nickel Silver, 65-10	Cu 65.00; Ni 10.00; Zn 25.00	745 — Better electrical conductivity than the 55-18 grade. Spring temper supplied in wire only.
Beryllium Copper ASTM B194-55; B196-52	Cu 98.00; Be 2.00	172 — Electrical switches and components. Can be formed in annealed condition and precipitation hardened to get high tensile strength. Good conductivity.
High-Silicon Bronze (A) ASTM B97	Cu 94.80; Si 2.80-3.50; can have small amounts of Fe, Zn, Mn, or Ni	655 — Silicon bronze has excellent resistance to corrosion.

SPRING ALLOYS (continued)

Name or Trademark and Specification	Nominal Composition %*	Properties and Typical Uses
NICKEL-BASE ALLOYS		
Monel Alloy QQ N-281a (Cl. A) MIL-N-894 C (Cl. A)	Ni 67.00; Cu 30.00	Resists sea water corrosion, is nearly nonmagnetic. Often used in food and beverage equipment. Torsion working stress 50,000-63,000 psi; bending working stress 88,000-107,000 psi. Temperature range: —100 to 400° F.
"K" Monel Alloy QQ-N-286a MIL-W-4471 (Comp. A) MIL-N-17506A (Cl. A)	Ni 63.00-70.00; Al 2.00-4.00; Ti 0.25-1.00; Cu bal	A precipitation hardening alloy. Higher tensile strength than Monel. Nonmagnetic and can be used at temperatures of —100 to 450° F. Torsion working stress 60,000-70,000 psi; bending working stress 110,000-120,000 psi.
Inconel Alloy QQ-W-390a	Ni 72.00 min; Cr 14.00-17.00; Fe 6.00-10.00	Nonmagnetic, good corrosion resistance, stands temperatures up to 650° F. Useful at subzero temperatures. Used in steam valves, regulating valves, springs in boilers, compressors, turbines, jet engines. Torsion working stress 55,000-80,000 psi; bending working stress 110,000-135,000 psi.
Inconel "X" Alloy AMS-5698 AMS-5699	Ni 70.00 min; Cr 14.00-17.00; Fe 5.00-9.00; Ti 2.00-2.50; Al 0.40-1.00; Cb 0.70-1.20	A precipitation hardening alloy. Nonmagnetic. May be used up to 1100° F, depending on design stresses. Useful at subzero temperatures. Torsion working stress 55,000-85,000 psi; bending working stress 110,000-135,000 psi.
A286, NS 286	Cr 13.5-16; Ni 24-27; Mo 1.0-1.75; Al 0.35 max; Ti 2.0-2.5; V 0.10-0.50	Operating range of 600-1000° F at moderate cost.
Rene 41	Ni 53; Cr 19; Co 11; Mo 10; Al 1.7 Ti 3.0	High strength precipitation hardening high temperature alloy. Wire and flat springs.
COBALT-BASE ALLOYS		
Elgiloy	Co 40.00; Cr 20.00; Ni 15.00; Mo 7.00; Mg 2.00; C 0.15; Be 0.04; Fe bal	Used for power, compression, extension, torsion and leaf springs. Fatigue and set resistant. High corrosion resistance, nonmagnetic, low hysteresis and drift. Torsion working stress 125,000 psi; bending working stress 250,000 psi. For applications from —85 to 700° F.
Dynavar Dynamet	Ni 13.00; Fe 17.00; Cr 2.00; Co 42.00; W 2.50	Suitable for subzero and up to 750° F temperatures, provided torsional stresses are kept under 75,000 psi. Used in watches and instruments for springs and diaphragms.
Havar	Co 42.00; Cr 20.00; Ni 13.00*	Instrument springs, drive bands, and magnetic shields.
S 816	Co 43.00; Ni 20.00; Cr 20.00; Mo 4.00; W 4.00; Cb 4.00; Fe 3.00	Good high temperature properties. Used for instrument and watch springs.
Haynes Alloy 25, NS25 (L605)	Cr 20.00; Fe 3.00 max Co 51.50; W 15.00; Ni 10.00;	Useful for springs operating at temperatures above 1100° F; or below 600° F where cold work strength is retained.
CONSTANT MODULUS ALLOYS		
Ni-Span-C Elinvar Extra	Ni 41.00-43.00; Cr 4.90-5.50; Ti 2.10-2.50; Fe bal	Precipitation hardening alloy. Excellent thermoelastic characteristics over the range of —50 to 150° F. Torsion working stress 60,000 psi; bending working stress 15,000-110,000 psi. Used in control, timing, and measuring equipment.
Iso-Elastic	Ni 35.00-37.00; Cr 7.00-7.60; Mo 0.35-0.70; Fe bal	Used principally in dynamometers, instruments, and food weighing scales. Its temperature compensating characteristics meet requirements of national and state boards of weights and measures. Torsion working stress 40,000-60,000 psi; bending working stress 90,000-100,000 psi.
PRECIOUS METAL ALLOYS		
179	Ag 72.00; Cu 28.00	These alloys are used as springs primarily where the spring must also serve as an electrical contact as in relays, gyros, etc.
1177	Ag 99.50; Mg 0.3; Ni 0.20	
1110	Ag 75.00; Cu 24.50; Ni 0.50	
1534	Au 72.50; Ag 4.00; Cu 14.00; Zn 1.00; Pt 8.50	
1323	Au 41.65; Cu 32.61; Ni 18.64, Zn 7.10	
1545	Au 75.00; Ag 22.00; Ni 3.00	
503	Au 75.00; Cu 1.00; Ni 18.50, Zn 5.50	
934	Ag 30.00; Au 10.00; Cu 14.00; Pd 35.00; Pt 10.00; Zn 1.00	

*Only major elements listed.

MAGNESIUM

Alloys ASTM No.	Nominal Composition % (Mg is remainder)	Properties
SAND CASTINGS		
AZ63A	Al 6.0; Zn 3.0; Mn 0.2	Military and commercial. Good properties but subject to porosity. Used in all conditions of treatment.
AZ81A	Al 7.6; Zn 0.7; Mn 0.2	Wheel castings (heat treated). Properties comparable to AZ63A; less susceptible to porosity.
AZ91C	Al 8.7; Zn 0.7; Mn 0.2	Heat treated and aged: same properties as AZ63A, less susceptible to porosity.
AZ92A	Al 9.0; Zn 2.0; Mn 0.2	Primarily used as heat treated and aged. Highest yield strength of the aluminum containing magnesium alloys.
AM100A	Al 10.0; Mn 0.2	Similar to AZ92A.
ZE41A	Zn 4.2; rare earths 1.2; Zr 0.7	Good strength and stability. Used in aged condition.
ZK51A	Zn 4.5; Zr 0.7	High ductility and yield strength. Difficult to cast complex sections. Used in aged condition.
ZK61A	Zn 6.0; Zr 0.7	Higher yield than ZK51A. Difficult to cast complex sections. Used in heat treated and aged condition.
ZH62A	Zn 5.7; Th 1.8; Zr 0.7	Properties similar to ZK51A but better castability. Used in aged condition.
QE22A	Ag 2.5; Di 2.2; Zr 0.7	This and ZK61A have highest yield strength at room temperature. Retains properties at about 600° F. Used in heat treated and aged condition.
EZ33A	Rare earths 3.3; Zn 2.5; Zr 0.7	Good pressure tight alloy. Retains properties to about 500° F. Used in aged condition.
HK31A	Th 3.3; Zr 0.7	Retains properties to about 700° F; used heat treated and aged. Thorium alloys are difficult to cast free from inclusions.
HK32A	Th 3.3; Zn 2.1; Zr 0.7	Retains properties to about 700° F. Used in aged condition. Thorium alloys are difficult to cast free from inclusions.
K1A	Zr 0.7	High damping properties. Subject to shrinkage defects in casting. Used as cast.

(Continued on Page S-20)

MAGNESIUM (continued)

Alloys ASTM No.	Nominal Composition % (Mg is remainder)	Properties

PERMANENT MOLD CASTINGS

Some of the alloys used for sand casting can also be used for permanent mold work. Compositions and properties are similar to sand cast. Most common are AM100A, AZ81A, AZ91C and AZ92A.

DIECASTINGS

AZ91A	Al 9.0; Zn 0.7; Mn 0.20; Cu 0.10 max	Specification grade. Good strength, ductility, and castability.
AZ91B	Al 9.0; Zn 0.7; Mn 0.20; Cu 0.30 max	Standard grade. Good strength, ductility, and castability.

FORGINGS AND EXTRUSIONS

M1A	Mn 1.5	Used where stress relief after welding is not possible and strength requirements not severe.
AZ31B	Al 3.0; Zn 1.0; Mn 0.45	Most common extrusion alloy. Has moderate strength and good formability.
AZ61A	Al 6.5; Zn 1.0; Mn 0.30	Has improved strength over AZ31B, but not as formable.
AZ80A	Al 8.0; Zn 0.5; Mn 0.25	Has improved strength over AZ61A, but less ductility. Can be aged.
ZK21A	Zn 2.3; Zr 0.6	Has good strength and is weldable without need for stress relief. (Available as extrusions only.)
ZK60A	Zn 5.7; Zr 0.55	High strength and toughness. Used mostly in aged condition.
(P)ZK60B	Zn 6.2; Zr 0.55	Higher strength than ZK60A. Extrusions made from pellets rather than billets. (Available as extrusions only.)
EK31XA	Di 3.2; Zr 0.6	For elevated temperatures (up to 500° F). Used in heat treated, quenched, and aged condition. (Available as forgings only.)
HK31A	Th 3.3; Zr 0.7	For elevated temperatures (400-600° F). Used in heat treated and aged condition.
HM21A	Th 2.0; Mn 0.5	For elevated temperatures (500-700° F). Used in aged condition. (Available as forgings only.)
HM31A	Th 3.0; Mn 1.5	For elevated temperatures (up to 800° F). (Available as extrusions only.)

SHEETS AND PLATES

AZ31B	Al 3.0; Zn 1.0	Most common sheet alloy. Good formability and weldability.
ZE10A	Zn 1.2; R.E. 0.2	Similar to AZ31B. Does not need stress relief after welding.
HK31A	Th 3.0; Zr 0.7	For elevated temperatures (400-600° F).
HM21A	Th 2.0; Mn 0.5	For elevated temperatures (400-800° F).

COPPER WROUGHT ALLOYS

As specified by the Copper & Brass Research Association

Copper No.	Alloy and Nominal Composition %[1]	Forms[2]	Machinability[3]	Properties and Applications
110	Electrolytic tough pitch (Cu 99.90 min; O 0.04)	R,D,S,W,T	20	Electrical, thermal conductor. Radiators, wire flashing.
122	Deoxidized (Cu 99.90 min; P 0.02)	R,D,S,T	20	Forming, bending good. Plumbing, refrigeration, oil lines.
102	Oxygen-free copper (Cu 99.92 min)	R,D,S,W,T	20	Deep drawing. Glass-to-metal seals, electronics, bus bars.
210	Gilding, 95% (Cu 95; Zn 5)	R,W	20	High polish; base for gold plate. Jewelry, emblems, medals.
220	Commercial bronze, 90% (Cu 90; Zn 10)	R,D,W,T	20	For cold working. Compacts, lipstick cases, screws.
226	Jewelry bronze, 87.5% (Cu 87.5; Zn 12.5)	R,W	30	Base for gold plate. Zippers, plaques, chains, jewelry.
230	Red brass, 85% (Cu 85; Zn 15)	R,W,T	30	Resists corrosion. Heat exchangers, trim, conduit, dials.
240	Low brass, 80% (Zn 20)	R,W	30	For deep drawing. Bellows, musical instruments, dials.
260	Cartridge brass, 70% (Cu 70; Zn 30)*	R,D,W,T	30	Good ductility, strength. Cartridge cases, springs, pins.
268	Yellow brass (Cu 65; Zn 35)	R,D,W	30	Cold workability and corrosion resistance. Lamps, hinges.
280	Muntz metal (Cu 60; Zn 40)	R,D,T	40	High strength, low ductility. Condenser plates, forgings.
314	Leaded coml. bronze (Cu 89; Pb 1.75; Zn 9.25)	R,D,S	80	Screw machine parts, screws, pickling crates, buckles.
330	Low leaded brass (tubing) (Cu 66; Pb 0.5; Zn 33.5)	T	60	Good machinability, moderate cold workability. J-bends, pipe, fuse parts, pump liners, trap tubes.
335	Low leaded brass (Cu 65; Pb 0.5; Zn 34.5)	R	60	Hardware (butts, hinges, sink strainers), watch backs.
340	Medium leaded brass (Cu 65; Pb 1; Zn 34)	R,D,S,W	70	Hardware (butts, gears) clock plates, dials, nuts.
332	High leaded brass (tubing) (Cu 66; Pb 1.6; Zn 32.4)	T	80	Fabricated by machining, piercing, punching. General purpose screw machine products.
342	High leaded brass (Cu 65; Pb 2.0; Zn 33.0)	R,D	90	Free machining with good blanking properties. Nameplates, keys, lock parts, gears, clock and watch parts.
356	Extra high leaded brass (Cu 63; Pb 2.5; Zn 34.5)	R	100	For blanking, machining, piercing, stamping; clock plates, nuts, clock and watch backs, clock gears, wheels.
360	Free-cutting brass (Cu 61.5; Pb 3; Zn 35.5)*	R,D,S	100	High speed screw machine parts. Gears, pinions, drilling.
365	Leaded Muntz metal (Cu 60; Pb 0.6; Zn 39.4)	R	60	Improved machinability. Condenser tube plates.
370	Free-cutting Muntz metal (Cu 60; Pb 1; Zn 39)	T	70	Improved machinability. Automatic screw machine parts.
377	Forging brass (Cu 59; Pb 2; Zn 39)	R,D,S	80	Plastic when hot. Forgings, pressings of all kinds.
385	Architectural bronze (Cu 57; Pb 3; Zn 40)	D,S	90	For forging, free machining. Extrusions, moldings, trim.
443–5	Inhibited admiralty (Cu 71; Zn 28; Sn 1)	R,W,T	30	Strength, ductility, corrosion resistance. Condenser, heat exchanger tubes and plates; auto aerials, marine uses.
464	Naval brass (Cu 60; Zn 39.25; Sn 0.75)*	R,D,S,T	30	Marine uses, condenser plates, shafts, valve stems.
485	Leaded naval brass (Cu 60; Pb 1.75; Zn 37.5; Sn 0.75)*	R,D,S	70	Like free-cutting brass with more corrosion resistance.
675	Manganese bronze (A) (Cu 58.5; Fe 1.4; Zn 39.0; Sn 1; Mn 0.1)	R,D,S	30	Wear resistance, high strength. Clutch discs, pump rods, valve stems and bodies, coal screens, condenser plates.
687	Aluminum brass (Cu 76; Zn 22; Al 2)	T	30	Resists impingement. Condenser and heat exchanger tubes.
510	Phosphor bronze, 5% (A) (Cu 95; Sn 5)*	R,D,S,W,T	20	High tensile, resists corrosion, season cracking. Bourdon tubing, diaphragms, switch parts, washers, springs.
521	Phosphor bronze, 8% (C) (Cu 92; Sn 8)*	R,D,S,W	20	For more severe conditions than above.
524	Phosphor bronze, 10% (D) (Cu 90; Sn 10)*	R,D,S,W	20	Extra spring qualities, resists fatigue. Expansion plates.
502	Phosphor bronze, 1.25% (E)* (Cu 98.75; Sn 1.25; P trace)	R,W	20	Good hot working properties but requires careful control. Low duty contacts and springs, hose, cold heading stock.
544	Free-cutting Phosphor Bronze* (Cu 88; Pb 4; Zn 4; Sn 4)	R,D,S	80	Good cold workability, improved machinability. Bearings, bushings, gears, pinions, shafts, thrust washers, valve parts.
715	Cupro-nickel, 30% (Cu 70; Ni 30)	R,D,T	20	Strength, ductility, corrosion resistance. Condensers, meters, plates, heat exchanger tubing, salt water tubing.
706	Cupro-nickel, 10% (Cu 88.7; Fe 1.3; Ni 10)	R,T	20	Resists salt water. Condenser tubing and plates, pipe.
752	Nickel silver, 65-18 (Cu 65; Zn 17; Ni 18)	R,D,W	20	Deep drawing, resists tarnish. Zippers, flatware.
770	Nickel silver, 55-18 (Cu 55; Zn 27; Ni 18)	R,D,W	30	Spring stock, resists fatigue. Springs, diaphragms.
754	Nickel silver, 65-15 (Cu 65; Zn 20; Ni 15)	R	20	Resists tarnish; hollow ware, nameplates, camera parts.
757	Nickel silver, 65-12 (Cu 65; Zn 23; Ni 12)	R,D,W	20	Deep drawing. Hollow ware, slide fasteners, trim.
745	Nickel silver, 65-10 (Cu 65; Zn 25; Ni 10)	R,D,W	20	Similar to above. Screws, flatware, platers' bars.
655	High-silicon bronze A (Cu 94.8 min; Si 3)	R,D,S,W,T	30	Corrosion resistance of copper; physicals of mild steel. Hydraulic lines, tanks, bolts, screws, pole line hardware.
651	Low-silicon bronze B (Cu 96.0 min; Si 1.5)	R,D,S,W,T	30	Cold headed bolts, nuts, screws; clamps, cotter pins.

1. Only major elements listed.
2. Abbreviations: R—Rolled flat products.
   D—Rod and drawn flat products. T—Tubing.
   S—Shapes. W—Wire (except flat).
3. Basis: Free-cutting brass = 100.

* This grade is also covered by an ASTM specification.

COPPER ALLOYS

Special wrought alloys not listed in the Copper & Brass Research Association's Manual of Standard Alloys

Copper No.	Alloy or Trademark	Source—See Key	Nominal Composition %	Properties and Typical Uses
	Boron Deoxidized Copper	1, 10	Cu 99.98; B 0.02	Strip, wire, rods, bars—High conductivity deoxidized copper for electrical apparatus.
	Lithium Deoxidized Copper	10, 12, 16	Cu 99.98; Li 0.004	Tubes and pipe. High electrical conductivity.
111	High-Thermo (Mod. Electrolytic Tough Pitch)	10	Cu 99.90 (plus small quantity of an element added to increase resistance to annealing)	Wire, bars, commutator section stock—High conductivity electrical uses, where greater retention of strength is desired at temperatures that normally soften electrolytic copper.
113	Silver Bearing Copper	9, 10, 12	Cu 99.9, Ag 8-25 oz. per ton	Electrical applications. Resists softening.
150	Zirconium Copper	1, 4	Cu 99.88; Zr 0.12	Strip, wire, rods—Soldering iron tips, resistance welding wheels and electrodes, miscellaneous current carrying parts, high temperature uses. Good conductivity.
147	Sulfur Copper	1, 4, 10, 12	Cu 99.7; S 0.3	Forgings, strip, wire, rods—Electrical parts, welding torch tips, soldering iron tips. Free machining.
142	Phosphorized Arsenical Copper	1, 4, 10, 12	Cu 99.68; P 0.02; As 0.30	Tubes—Condenser and heat exchanger tubes.
145	Tellurium Copper	1, 4, 6, 7, 10, 12, 13	Cu 99.50; Te 0.50; P 0.007	Rods, bars, extrusions, die-pressed forgings—Gas cutting torch and welding tips, screw machine and other parts requiring high conductivity.
182 184 185	Chromium Copper	1, 2, 4, 7, 10	Cu 99.0; Cr 1.00	Rods, bars, shapes, forgings, sheets, strip, castings—Spotwelding tips, seamwelder rolls, flashwelding dies, electrical contacts, Properzi wheels, commutator segments, rotor bars, plating rolls, electrodes.
162 164	Cadmium Copper	1, 2, 4, 10	Cu 99.00; Cd 1.00	Sheets, strip, plates, wire, rods, bars—Electrical conductors, electrodes, pole line hardware.
	Leaded Copper	1, 4, 10	Cu 99.00; Pb 1.00	Rods and bars—High conductivity screw machine products.
	Deoxidized Leaded Copper 129	1, 10	Cu 98.99; Pb 1.00; B 0.01	Rods and bars. High conductivity screw machine products.
190	Phosnic Bronze Nickel-Phosphorus Bronze	6, 10	Cu 98.65; Ni 1.10; P 0.25	Rods, wire, strip—Rivets, screws, springs, electrical parts.
165	Cadmium Bronze	1, 10	Cu 98.60; Sn 0.60; Cd 0.80	Sheets, strip, plates, wire, rods, bars—Wire and cable for electrical conductors.
507	Copper Tin	4	Cu 98.25; Sn 1.85	Strip, sheets, rods, wire, Fourdrinier wire, electrical conductor.
191	Telnic Bronze (Nickel-Phosphorus Bronze)	6, 10	Cu 98.15; Ni 1.10; Te 0.50; P 0.25	Rods—Forgings and screw machine parts requiring high strength, good conductivity.
651	Silicon Copper B (Silicon Bronze B)	6, 10, 12	Cu 98; Si 1.75; Mn 0.50; Zn 1.0	Sheets, strip, plates, rods, forgings, wire.
	Leaded Nickel Copper, 831	1	Cu 97.80; Pb 1.00; Ni 1.00; P 0.20	Rods—Electrical equipment, high conductivity screw machine products.
647	Nickel-Silicon Copper	1, 4, 6	Cu 97.5; Ni 1.9; Si 0.6	Strip, rods, wire, bars—Pole line hardware, switch gear, nuts, bolts, electrical equipment, springs.
	Cobalt Beryllium Copper 900	2, 7	Cu 97; Co 2.6; Be 0.4	Resistance welding tips, welding wheels, etc.
655	Herculoy 420 (Silicon Bronze A)	6, 10, 12	Cu 96; Si 3; Mn 1	Sheets, strip, plates, rods, forgings.
655	Silicon Copper A	..	Cu 96.00; Si 3.00; Zn 1.00	Sheets, strip—Bearing plates, evaporators, certain marine hardware, special tanks.
661	Leaded Silicon Bronze	1	Cu 95.60; Pb 0.40; Si 3.00; Mn 1.00	Rods—Screw machine products.
	Calsun Bronze, 951	1	Cu 95.50; Sn 2.00; Al 2.50	Wire, rods, bars—Wire and cable for electrical conductors.
405	Olin Bronze 86, Revere 309	9, 12, 18	Cu 95.0; Zn 4.0; Sn 1.0	Electrical spring contacts, fuse clips, electrical parts.
606	Aluminum Bronze, 5%	1, 12	Cu 95.00; Al 5.00	Tubes, rods, bars, sheets, strip, plates, wire—Condenser and heat exchanger tubes, foreign coinage, architectural decoration to imitate gold.
608	Aluminum Bronze 53, Revere 429	4, 10, 12	Cu 94.25; Al 5.50; As 0.25	Tube condenser and heat exchanger.
	Ambronze, 474	1	Cu 94.97; Zn 4.00; Sn 1.00; P 0.03	Sheets, strip, plates, wire—Electrical switch parts and springs.
534	Leaded Phosphor Bronze, (B)-379	1, 4, 18	Cu 93.00; Sn 5.00; Pb 1.00; P 0.10	Strip, wire, rods, bars, tubes—Screw machine products.
	Brazing Bronze, 222	9	Cu 93.00; Zn 4.70; Fe 2.30	Sheets, strip—Retains fine grain size up to about 1600-1700° F. Used for furnace brazing, electrical applications such as circuit breaker arms, terminals.
705	Cupro Nickel, 142	9	Cu 93; Ni 7.0	Fuse components, resistance springs.
413	Ambronze 404, Revere 312	1, 12	Cu 92.00; Zn 7.00; Sn 1.00	Strip, rods, bars—Spring and contact applications in electrical equipment and hardware, plater's bar.
415	Tin Brass, 2%	4, 7, 8, 11, 13, 14, 18	Cu 92; Sn 2; Zn 6	Strip—General spring and contact applications in electrical and hardware fields.
702	Copper Nickel	4, 18	Cu 98; Ni 2	Wire, resistance wire.
612	Aluminum Bronze, 8%	1, 2	Cu 92; Al 8	Sheets, strip, plates, wire, rods, bars—Valve stems, coins, medallions, plaques.
	Duronze, 708	2, 4	Cu 91.43; Al 6.75; Si 1.75; As 0.07	Rods, wire, bars, forgings. Excellent hot working capacity without loss of strength when returned to normal temperatures. Uses include valve materials, high strength, corrosion resistant fasteners.
614	Aluminum Bronze, 7%	2, 12	Cu 91; Al 7; Fe 2	Sheets, plates, extruded rods, tubes, pipes, shapes—Mechanical and processing fabrications, conveyors, liners, heads, slides, gibs, and wear strips.
639	Aluminum Silicon Bronze	1, 2, 4, 6, 7, 12	Cu 91; Al 7; Si 2	Rods, bars—Valve stems and parts, wire cable connector parts, bolts and nuts, hot forged parts, marine hardware, gears. Good corrosion resistance.
316	Nickel Leaded Commercial Bronze	1, 6, 15	Cu 90.25; Zn 6.90; Pb 1.75; P 0.10; Ni 1.00	Rods, bars, tubes—Pole line hardware and other parts subject to outdoor exposure. Rods—Machined nuts, screw machine parts.

(Continued on Page S-22)

COPPER ALLOYS (continued)

Copper No.	Alloy or Trademark	Source—See Key	Nominal Composition %	Properties and Typical Uses
419	Tin Brass, 1%	8, 13	Cu 90.00; Sn 1.00; Zn 9.00	Strip—Special springs, contacts, jewelry, sockets, switch parts for electrical and hardware field.
616	Aluminum Bronze	2, 4, 7	Cu 90; Al 9; Fe 1.00	Rods, wire, welding rods. Excellent hot working capacity, high strength with good corrosion resistance. Uses include valve parts, fasteners, forgings.
411	Tin Brass, 0.5%; Lubalioy 84	4, 9, 13	Cu 90.00; Sn 0.50; Zn 9.50	Sheets, strip—Bearing alloy for bushings, bearings, clutch plates, washers, jewelry, bezels, weather strip.
415	Tin Brass, 1.75%	9, 12	Cu 90.00; Zn 8.25; Sn 1.75	Sheets, strip—Radio tube socket contacts, fuse clips, contact springs, lock washers, solderless connectors, jewelry, coins, electric fan blades, medallions.
314	Scovill, 215	13	Cu 90; Pb 2; Zn 8	Rods—High conductivity bronze.
	Hardware Bronze "B" 89	4	Cu 89.50; Zn 8.50; Pb 2.00	Rods, wire. Rich bronze color, good machinability and corrosion resistance. Uses include fasteners, connectors, hardware, etc.
546	Leaded Bearing Bronze, 116	9, 18	Cu 89; Zn 2.75; Sn 4.00; Pb 4.00	Sheets, strip—Bearings and bushings in automobiles, aircraft.
618	Avialite, 915	1	Cu 89.25; Sn 0.40; Al 9.25; Ni 0.50; Fe 0.60	Rods, bars, die-pressed forgings—pickling crates. Used where strength and resistance to corrosion at high temperatures are required as in parts for internal combustion engines.
420	Contact Bronze, 92 (Tin Brass)	4, 17, 18	Cu 89.00; Sn 1.80; Zn 8.20; P 0.15	Strip—Electrical and radio spring applications.
708	Cupro Nickel, Olin 144	9	Cu 88.5; Ni 11.5	Fuse components.
422	Ambronze, Chain Bronze Lubronze 83	1, 9, 12, 17	Cu 88; Zn 11; Sn 1	Strip, wire, tubes—Spring and switch parts for electrical apparatus and hardware.
	Ni-Vee Bronze	2	Cu 88; Ni 5; Sn 5; Zn 2	Strip, rods—Valve stem fasteners, hardware. Heat treatable alloy.
624	Aluminum Bronze 224-C	2, 7	Cu 87.5; Al 9.75; Fe 2.75	High strength, resistant to corrosion, acid, oxidation at high temperatures; light weight. Aviation valve seats, valve guides. More resistant to corrosion cracking under load than Cu-Zn alloys.
706	Copper Nickel Cufenloy 10	10	Cu 88.2; Ni 10; Fe 1.3; Mn 0.5	Condenser and heat exchanger tubes, salt water piping.
425	Tin Brass, 2%	1, 4, 5, 9, 10, 12, 17	Cu 88; Sn 2; Zn 10	Strip—Cold workable alloy, characterized by its toughness, ductility, spring quality, high tensile strength, high electrical conductivity, corrosion resistance.
544	Free Cutting Phosphor Bronze 819	4, 18	Cu 87.8; Sn 4.0; Pb 4.0; Zn 4.0; P 0.2	Rods. Similar in composition to cast leaded red brass only in wrought form. Good corrosion resistance, and machinability.
	High Strength Bronze 90 Hardware Bronze "B"	4	Cu 87.50; Zn 7.43; Pb 2.00; Ni 1.00; P 0.07	Rods. Age hardenable, formable, machinable high strength alloy. Uses include corrosion resistant fasteners, valve, and pump parts.
	Led-O-Loy	5	Cu 87; Sn 2; Pb 2; Zn 9; P 0.05	Strip—Machinability combined with strength and resistance to wear. For meter and gage components, bearings, washers, etc.
430	Ambronze, 422 Spring Bronze, Tin Brass	1, 4, 13, 18	Cu 87; Sn 2; Zn 11	Strip, wire, rods, bars—Spring and switch parts for electrical apparatus and hardware.
624	Aluminum Bronze	2	Cu 87.00; Al 9.50; Fe 3.20	Extruded solid and hollow rounds, shapes—Gears, small worm wheels, bushings, valve seats, guides.
685	Aluminum Bronze	9	Cu 87; Zn 7; Al 4; Fe 2	Sheets, strip—Bearings, bushings, thrust washers.
430	Brmcolloy, 300	5	Cu 86; Sn 2; Zn 12	Strip—High fatigue resistance for electrical contacts.
422	Brmcolloy, 200	5	Cu 86; Sn 1; Zn 13	Strip—Sash chain, electrical contacts, switch parts, and fuse clips.
432	Jewelry Bronze, 1/2%	5, 12	Cu 86.00; Sn 0.50; Zn 13.50	Strip—Jewelry chain, switch, and relay components.
620	Aluminum Bronze	2, 7	Cu 85.50; Al 10.50; Fe 3.50	Extruded solid and hollow rounds, shapes—Bushings, bearings, worms and worm wheels, valve seats and guides, hydraulic valve parts, plungers, pump rods, guide-pin bushings, gibs, slides.
	Manganese Red Brass, 507	1	Cu 85; Zn 14; Mn 1	Sheets, strip—Resistance spotwelding and seamwelding.
320	Hardware Bronze	1, 4	Cu 85.00; Zn 13.25; Pb 1.75	Rods, bars—Hardware, screw machine products.
432	Glo-Ray	8	Cu 85; Zn 14.50; Sn 0.50	Jewelry and allied fields, where color and strength are factors.
	Silicon Red Brass, 1027	1	Cu 82; Zn 17; Si 1	Sheets, strip, plates, wire—Resistance welding.
628	Ambraloy, 917	1, 2	Cu 82; Al 9.50; Mn 1; Ni 5; Fe 2.50	Plates, rods, bars, die-pressed forgings—Tube sheets for heat exchangers.
665	Manganese Red Brass	4	Cu 81.00; Mn 1.25; Zn 17.75	Strip—Spotwelding and seamwelding.
	High-Silicon Brass	4, 12, 15	Cu 81; Si 4; Zn 15	Rods, diecastings, forgings—Valve parts, pole line hardware.
628	Nickel Aluminum Bronze	2, 7	Cu 81; Ni 5.0; Al 10; Fe 2.5; Mg 1.0	Heat treatable. High physical properties. Used in aviation industry for spacers, gears. Used in operation of retractable landing gear. More resistant to corrosion cracking under load than copper-zinc alloys.
687	Aluminum Brass (Revalon 435)	10, 12	Cu 76; Zn 22; Al 2; As 0.05	Tubes for condenser and heat exchanger use.
	18% Ni Silver	9, 12	Cu 72; Zn 10; Ni 18	Deep drawing, fishing rod ferrules, trophies, musical instruments.
	12% Ni Silver, Olin 176	9	Cu 70.0; Zn 18.0; Ni 12.0	Fishing reels & tackle, musical instruments, coins, nameplates, slide fasteners.
667	Manganese Brass	1, 4, 9, 12	Cu 70.00; Zn 28.90; Mn 1.10	Sheets, strip—Same physical characteristics as cartridge brass except for lower electrical conductivity, permitting easier spot and seamwelding.
	Alloy 77	4	Cu 69.50; Zn 30.45; Hg 0.05	Tube. Corrosion resistant antibiofouling alloy for condenser and heat exchanger applications.
262	High Brass, Olin 33	9	Cu 68.5; Zn 31.5	Drawn shells, radiator lock seam tubing, tanks, ferrules, hardware.
745	10% Ni Silver	8, 9	Cu 66.5; Zn 23.5; Ni 10.0	Arch supports, slide fasteners, fishing tackle.
670	Manganese Bronze (High Tensile, Grade B)	7, 15	Cu 65; Zn 23; Al 5.0; Fe 3.0; Mg 4.0	High strength, toughness, resistant to shock, wear, salt water corrosion, high hydraulic pressures. Used for rollers, rotors, valve stems. Nonmagnetic.
782	Leaded Ni Silver	9, 12, 18	Cu 64.5; Zn 27.9; Ni 7.9; Pb 1.5	Keys, watch plates, lock parts, good corrosion resistance.
790	Leaded Ni Silver	9, 12, 18	Cu 64.5; Zn 24.0; Ni 12.0; Pb 1.5	Keys, watch plates, wheels, lock plates.
707	Cupro Nickel, 30%	1, 18	Cu 64.5; Fe 5.25; Mn 0.60	High strength copper nickel iron alloy for high temperature service as heat exchanger tubes in feed water heaters.

COPPER ALLOYS (continued)

Copper No.	Alloy or Trademark	Source—See Key	Nominal Composition %	Properties and Typical Uses
340	Leaded Brass, Olin 62	9	Cu 64.00; Zn 35.0; Pb 1.0	Key stock, maximum machinability for 1% Pb alloy, builders' hardware, electrical parts.
274	Nebalioy	8	Cu 63; Zn 37	Strip for electrical and hardware uses.
353	Leaded Brass	6, 9, 15	Cu 62.5; Pb 2.0; Zn 35.5	Sheets, strip, rods—Screw machine products involving secondary operations such as flanging, knurling roll threading, spinning, and staking.
350	Spinning Brass—R-65	3	Cu 62.5; Pb 1.25; Zn 36.25	Rods—Combines free machining with excellent cold working properties, such as spinning, flaring, and swaging.
786	Leaded Ni Silver	9, 18	Cu 61.5; Zn 27.0; Ni 10.0; Pb 1.5	Substitute for high brass.
353	Thread Rolling-Free Cutting Brass, Clock Brass	7, 9, 15	Cu 61.00; Pb 1.75; Zn 37.25	Rods—Screw machine products. Sheets—Keys, clock and watch parts.
	Nonleaded Bearing Alloy	3, 7	Cu 61.00; Mn 2.50; Si 1.00; Zn 35.50	Rods—Screw machine products, cams.
	Medium-Leaded Bearing Alloy, 602	7	Cu 61.00; Mn 2.50; Si 1.00; Pb 1.00; Zn 34.50	Rods—Screw machine products, shaft bushings.
	High-Leaded Bearing Alloy, 604	2, 7	Cu 61.00; Mn 2.50; Si 1.00; Pb 2.50; Zn 33.00	Rods—Screw machine products.
	Low-Leaded Bearing Alloy, 605	7	Cu 61.00; Mn 2.50; Si 1.00; Pb 0.50; Zn 35.00	Rods—Screw machine products, hydraulic pump connecting rod retainers.
280	Brazing Brass, Western Brass 340	9	Cu 59.5; Pb 0.17; Zn bal	Low melting brazing sheets.
	Medium-Leaded Forgeable Bearing Alloy	3, 7, 15	Cu 60.00; Mn 2.50; Si 1.00; Pb 1.00; Zn 35.50	Forgings—Hydraulic transmission gears, hydraulic pump cylinder barrels, bearings. Heat treatable.
	Leaded Forgeable Bearing—Alloy	3	Cu 60.00; Pb 0.75; Si 0.80; Mn 2.50; Zn 35.95	Rods and forgings. Gears and bushings.
	Low-Leaded Manganese Bronze	3, 15	Cu 58.50; Pb 0.60; Sn 1.00; Fe 1.00; Mn 0.35; Zn 38.55	Rods and forgings. Clutch discs, pump rods, shafting, valve stems and bodies.
	Forgeable Bearing Alloy	3, 7, 15	Cu 58.00; Mn 2.50; Si 0.75; Al 1.50; Zn 37.25	Forgings, rods—Screw machine products, chain saw clutch bearings, squirrel cage feed fingers, hydraulic pump driving cams, lead screw nuts.
	Architectural Bronze—R56 C	3	Cu 58.00; Al 0.15; Fe 0.15; Mn 0.15; Zn 41.55	An architectural bronze having a golden color. Welds well. Rod, shapes, and forgings.
	Manganese Bronze—R-57	3	Cu 57.50; Al 3.00; Fe 2.00; Mn 3.0; Zn 34.50	Used for parts which are subjected to heavy loads. Rods and forgings.
	Manganese Bronze—R-56	2, 3	Cu 57; Al 1; Fe 1; Zn 41	Rods, shapes and forgings. High strength, high hardness manganese bronze. Valve stems and counter weights.
766	Nickel Silver, 12%	1, 9, 12, 14, 18	Cu 56.50; Zn 31.50; Ni 12.00	Strip—Springs and instrument parts.
	Tinicosil, 54 (Extruded Leaded Nickel Silver)	15	Cu 47.00; Ni 10.00; Pb 2.25; Mn 2.00; Zn 38.75	Round and hexagon rods—Screw machine products, instrument parts, fishing tackle, valve and plumbing parts.
774	Tinicosil, 53 (Extruded Nickel Silver)	12, 15	Cu 46; Ni 10; Zn 44	Forgings—Plumbing, valves, instrument parts.
	Leaded Nickel Silver, 10%	1	Cu 45; Zn 42; Ni 10; Pb 1; Mn 2	Rods, bars, extruded shapes, forgings—Screw machine products, instrument parts, ornamental architectural shapes.

KEY TO SOURCE:

(1) Anaconda American Brass Co., Waterbury, Conn.
(2) Ampco Metal Inc., Milwaukee.
(3) Bohn Aluminum & Brass Corp., Detroit.
(4) Bridgeport Brass Co., Bridgeport, Conn.
(5) Bridgeport Rolling Mills Co., Stratford, Conn.
(6) Chase Brass & Copper Co. Inc., Waterbury, Conn.
(7) Mueller Brass Co., Port Huron, Mich.
(8) New England Brass Co., Taunton, Mass.
(9) Olin Metals Div., East Alton, Ill.
(10) Phelps Dodge Copper Products Corp., New York.
(11) Plume & Atwood Mfg. Co., Thomaston, Conn.
(12) Revere Copper & Brass Inc., New York.
(13) Scovill Mfg. Co., Waterbury, Conn.
(14) Miller Co., Meriden, Conn.
(15) Titan Metal Mfg. Co., Bellefonte, Pa.
(16) Wolverine Tube Div., Allen Park, Mich., Calumet & Hecla Inc.
(17) Bristol Brass Corp., Bristol, Conn.
(18) Riverside-Alloy Metal Div., Riverside, N. J., H. K. Porter Company Inc.

BERYLLIUM-BEARING ALLOYS

Producers' Designations			
Brush Beryllium Co.	Beryllium Corp.	Nominal Composition %	Properties and Applications
CASTING ALLOYS			
Master alloys			
Beryllium Copper	Beryllium Copper	Be 4.0; Cu bal	Used as a source of beryllium in compounding alloys.
Beryllium Aluminum	Beryllium Aluminum	Be 5.0; Mg 1.0 max; Al bal	
Beryllium Magnesium Aluminum		Be 5.0; Mg 0.50 max; Al bal	
	Beryllium Magnesium Aluminum	Be 5.0; Mg 3.0; Al bal	
Beryllium Nickel		Be 10.0-50.0 as spec.; Ni bal	
Copper base			
35 C		Be 0.25-0.50; Ni 1.40-1.60	High conductivity, heat treatable alloy for resistance welding dies and electrodes. Meet RWMA Class 3 specifications.
10 C	10–CR	Be 0.65; Co 2.50	High conductivity, heat treatable alloy with moderate strength and hardness. Maintains conductivity and hardness to 700° F. Circuit breaker and switch parts, resistance welding electrodes, butt-welding and projection welding dies. RWMA Class 3.
20 C	20–CR	Be 2.15; Co 0.50	Heat treatable alloy with good fluidity, low pouring temperature, excellent wear and corrosion resistance, high strength. Bearings, gears, cams, valve and pump parts, drawing dies.
	50–CR	Be 0.50; Co 1.55; Ag 1.10	High conductivity alloy for resistance welding dies and electrodes. Good hardness and strength, low surface contact resistance, resists oxidation at elevated temperatures. RWMA Class 3.
	70–CR	Be 0.15; Cr 0.90	Heat treatable, high conductivity, good fluidity. Class 2 alloy in resistance welding components.
240 C		Be 2.45; Ni 1.40	Heat treatable alloy having highest strength of copper-base alloys. Excellent mechanical properties with moderate conductivity.
275 C	275–CR	Be 2.75; Co 0.50	Heat treatable alloy with maximum hardness and wear resistance. Used in plastic molds, deep drawing dies.

(Continued on Page S-24)

BERYLLIUM BEARING ALLOYS (continued)

Producers' Designations: Brush Beryllium Co.	Beryllium Corp.	Nominal Composition %	Properties and Applications
Nickel base			
260 C		Be 2.55-2.80; C 0.40 max; Ni bal	Heat treatable alloys with excellent castability, extremely high strength and hardness, and good corrosion resistance. Used in turbine wheels, glass molds, plastic compression molds, valve bodies, and wrench jaws.
220 C		Be 2.00-2.30; C 0.40 max; Ni bal	
WROUGHT ALLOYS*			
Beryllium	Beryllium	Be	Nuclear and aerospace uses. Meets AEC requirements for purity. Lightweight structural material, good heat capacity.
Copper base			
25	25	Be 1.90; Co 0.25	In strip form, can be blanked, formed, deep drawn, or spun, then heat treated to provide maximum mechanical properties. They can be supplied in a mill hardened condition for limited forming operations. Uses include springs, diaphragms, bellows, electronic parts, bearings, gears, torsion bars, electrical connectors.
165	165	Be 1.70; Co 0.25	
	50	Be 0.40; Co 1.55; Ag 1.0	High conductivity alloy, good hardness and strength, resists oxidation at elevated temperatures. Bearings, gears, torsion bars, electrical connectors.
10	10	Be 0.50; Co 2.50	These alloys in the form of plates, bars, and forgings are used for welding dies, bus bars, plastic mold parts, drawing dies.
35		Be 0.35; Ni 1.50	
	Beryidur 4	Be 1.0; Co 0.25; Others	A moderate strength alloy. Same uses as 25 and 165 alloys.

*All the Brush Beryllium Co. wrought alloys are supplied as billets, plates, bars, and strip including the trademarked Pennrold Precision Strip. Beryllium Corp. Alloy 165 and the trademarked Beryidur are available in sheets and strip. Alloy 50 is supplied in rods, bars, and billets. Alloys 10 and 25 are available as billets, plates, sheets and strip, rods, and bars. Alloy 25 is also supplied in wire form.

COPPER CASTING ALLOYS

Alloy and Nominal Composition %	Machinability*	Properties and Applications
ASTM specification B143-52		
1A—Tin bronze (Cu 88; Sn 10; Zn 2)	50	Bearings and bushings, fasteners, valve bodies for temperatures to 550° F, steam pressure castings, oil pumps, carburetors, gears.
1B—Tin bronze (Cu 88; Sn 8; Zn 4)	50	
2A—Leaded tin bronze (Cu 88; Sn 6; Pb 1.50; Zn 4.5)	60	
2B—Leaded tin bronze (Cu 87; Sn 8; Pb 1; Zn 4)	60	
ASTM specification B144-52		
3A—High-leaded, tin bronze (Cu 80; Sn 10; Pb 10; Ni 0.75 max)	80	Bearing bronzes. Acid resisting. Those with highest copper content for heaviest loads. Bearings, shoes, wedges, bushings and uses where an antifriction, soft material is needed.
3B—High-leaded, tin bronze (Cu 83; Sn 7; Pb 7; Zn 3; Ni 0.50 max)	70	
3C—High-leaded, tin bronze (Cu 85; Sn 5; Pb 9; Zn 1; Ni 0.50 max)	70	
3D—High-leaded, tin bronze (Cu 78; Sn 7; Pb 15; Ni 0.75 max)	80	
3E—High-leaded, tin bronze (Cu 70; Sn 5; Pb 25; Ni 0.75 max)	90	
ASTM specification B145-52		
4A—Leaded red brass (Cu 85; Sn 5; Pb 5; Zn 5)	90	General purpose, moderate strength castings. Superior machinability. Plumbing goods, pumps, hardware, ornamental objects, low pressure valves. Air, gas, oil, and water fittings.
4B—Leaded red brass (Cu 83; Sn 4; Pb 6; Zn 7)	90	
5A—Leaded semired brass (Cu 81; Sn 3; Pb 7; Zn 9)	90	
5B—Leaded semired brass (Cu 76; Sn 3; Pb 6; Zn 15)	90	
ASTM specification B146-52		
6A—Leaded yellow brass (Cu 72; Sn 1; Pb 3; Zn 24)	80	Same type uses as red brasses. More difficult to cast, but sometimes preferred for color. Ferrules, andirons, furniture hardware, ship trimming.
6B—Leaded yellow brass (Cu 67; Sn 1; Pb 3; Zn 29)	80	
6C—Leaded yellow brass (Cu 61; Sn 1; Pb 1; Zn 36.35; Al 0.15)	..	
ASTM specification B147-52		
7A—Leaded, high strength, yellow brass (Cu 61; Sn 0.75; Pb 0.75; Zn 35.5; Fe 1; Al 0.75; Mn 0.25)	60	Used where strength and toughness are required. Heavy duty valve stems, gears, cams, bearings, hydraulic cylinder parts, marine fittings, lever arms, pump bodies, gas engine bases, brackets, screwdown nuts, hydraulic cylinder parts.
8A—High strength yellow brass (Cu 58; Zn 39.25; Fe 1.25; Al 1.25; Mn 0.25)	30	
8B—High strength manganese bronze (Varies to meet requirements)	30	
8C—High strength manganese bronze (Varies to meet requirements)	20	
ASTM specification B148-52		
9A—Aluminum bronze (Cu 88; Fe 3; Al 9)	20	Strong corrosion resistant alloys. Good high heat strength; 9B, C, and D are heat treatable. Gears, bushings, bearings, propellers, pickling baskets, valve seats, marine equipment, worms, heavy duty feed nuts.
9B—Aluminum bronze (Cu 89; Fe 1; Al 10)	35	
9C—Aluminum bronze (Cu 85; Fe 4; Al 11)	20	
9D—Aluminum bronze (Cu 81; Fe 4; Ni 4; Al 11)	20	
ASTM specification B149-52		
10A—Leaded nickel brass (Cu 57; Sn 2; Pb 9; Zn 20; Ni 12)	70	Sometimes called nickel silvers. Corrosion resistant hardware, plumbing fixtures, ornamental castings, dairy and soda fountain equipment, musical instruments, boat and railroad car fittings, trim.
11A—Leaded nickel bronze (Cu 64; Sn 4; Pb 4; Zn 8; Ni 20)	..	
11B—Leaded nickel bronze (Cu 66.5; Sn 5; Pb 1.5; Zn 2; Ni 25)	..	
ASTM specification B198-58		
12A—Silicon bronze (Sn 1 max; Pb 0.5 max; Zn 4 max; Fe 2.5 max; Mn 1.5 max; Al 1.5 max; Si 1-5; Cu rem)	..	Valve parts for corrosive conditions; good corrosion resistance in absence of oxygen. Naval parts, chemical parts, brackets, pole line hardware.
13A—Silicon brass (Pb 1 max; Zn 12-16; Si 2.5-4; Cu rem)	..	
13B—Silicon brass (Pb 0.5 max; Zn 12-16; Si 3-5; Cu rem)	..	
No ASTM specification		
Silicon-aluminum bronze (Cu 91; Al 7; Si 2)	50	Corrosion resistant. Higher strength than silicon brasses. Valves, radar parts, pressure castings. Heat treatable. Welding tips, nonsparking tools.
Silicon-aluminum bronze (Cu 90; Al 7; Si 3)	50	
Beryllium bronze (Cu 96.5; Ni 1.1; Be 2.2-2.8)	20-40	

*Basis: Free cutting brass = 100.

ALUMINUM WROUGHT ALLOYS

Aluminum Assn. Designation	Chemical Composition % max or range. Al remainder	Commercial Forms	Properties and Applications
EC	Al 99.45 min	S,W,B,E,T,R	Electric conductors.
1060*	Si 0.25; Fe 0.35; Cu 0.05; Mn 0.03; Mg 0.03; Zn 0.05; Ti 0.03; Al 99.60 min; others 0.03 each	S,T	Chemical equipment and railroad tank cars.
1100*	Si & Fe 1.0; Cu 0.20; Mn 0.05; Zn 0.10; Al 99.00 min	S,W,B,E,T,F,R	Sheet metalwork, spun hollow ware, and decorative parts. Good formability. Impact extrusions.**
1130	Si & Fe 0.7; Cu 0.20; Al 99.30 min	S	Used primarily for reflector sheet in lighting fixtures.
1145	Si & Fe 0.55; Cu 0.05; Mn 0.05; Al 99.45 min; others 0.03 each	Foil	Used in making foil.
1345	Si 0.30; Fe 0.40; Cu 0.10; Al 99.45 min; others 0.05 each	W	Mechanical wire.
2011	Si 0.40; Fe 0.7; Cu 5.0-6.0; Zn 0.30; Pb 0.20-0.6; Bi 0.20-0.6	W,B,R	Screw machine products.

ALUMINUM WROUGHT ALLOYS (continued)

Aluminum Assn. Designation	Chemical Composition % max or range. Al remainder	Commercial Forms	Properties and Applications
2014*	Si 0.50-1.2; Fe 1.0; Cu 3.9-5.0; Mn 0.40-1.2; Mg 0.20-0.8; Cr 0.10; Zn 0.25; Ti 0.15	S,B,E,T,F,R	Heavy duty structures, aircraft, and truck frames. High strength with good machinability.
Alclad 2014	(same as above)	S	Corrosion resistance is better than 2014.
2017	Si 0.8; Fe 1.0; Cu 3.5-4.5; Mn 0.40-1.0; Mg 0.20-0.8; Cr 0.10; Zn 0.25	W,B,R	Screw machine products. Higher strength than 2011.
2018	Si 0.9; Fe 1.0; Cu 3.5-4.5; Mn 0.20; Mg 0.45-0.9; Cr 0.10; Ni 1.7-2.3; Zn 0.25	F	Aircraft engine cylinder heads and pistons. High strength with good machinability.
2024	Si 0.50; Fe 0.50; Cu 3.8-4.9; Mn 0.30-0.9; Mg 1.2-1.8; Cr 0.10; Zn 0.25	S,W,B,E,T,R	Aircraft structures, truck wheels, screw machine products. High strength and hardness.
Alclad 2024	(same as above)	S	Same as 2024 with greater corrosion resistance.
2025	Si 0.50-1.2; Fe 1.0; Cu 3.9-5.0; Mn 0.40-1.2; Mg 0.05; Cr 0.10; Zn 0.25; Ti 0.15	F	Propeller blades and other high strength forgings.
2117	Si 0.8; Fe 1.0; Cu 2.2-3.0; Mn 0.20; Mg 0.20-0.50; Cr 0.10; Zn 0.25	W	Cold heading wire and rivets.
2218	Si 0.9; Fe 1.0; Cu 3.5-4.5; Mn 0.20; Mg 1.2-1.8; Cr 0.10; Ni 1.7-2.3; Zn 0.25	F	Aircraft engine cylinder heads and pistons, jet engine impellers and compressor rings.
3003*	Si 0.6; Fe 0.7; Cu 0.20; Mn 1.0-1.5; Zn 0.10	S,W,B,E,T,F,R	Cooking utensils, pressure vessels, tanks, piping, architectural uses, builders' hardware, foil.
Alclad 3003	(same as above)	S,T	Tea kettles, chemical equipment, heat exchange tubes, pressure vessels, storage tanks, flashing.
3004*	Si 0.30; Fe 0.7; Cu 0.25; Mn 1.0-1.5; Mg 0.8-1.3; Zn 0.25	S	Special sheet metalwork, shoe eyelets, pressure vessels, storage tanks.
Alclad 3004	(same as above)	S	Industrial building sheets and flashing.
4032	Si 11.0-13.5; Fe 1.0; Cu 0.50-1.3; Mg 0.8-1.3; Cr 0.10; Ni 0.50-1.3; Zn 0.25	F	Pistons, forging stock.
4043*	Si 4.5-6.0; Fe 0.8; Cu 0.30; Mn 0.05; Mg 0.05; Zn 0.10; Ti 0.20	W	Intermediate strength welding wire. Cladding on brazing sheets.
5005	Si 0.40; Fe 0.7; Cu 0.20; Mn 0.20; Mg 0.50-1.1; Cr 0.10; Zn 0.25	S	Refrigerator uses, architectural and auto trim.
5050*	Si 0.40; Fe 0.7; Cu 0.20; Mn 0.10; Mg 1.0-1.8; Cr 0.10; Zn 0.25	S,W,B,T,R	Decorative refrigerator parts, builders' hardware, coiled tubes; architectural and auto trim.
5052*	Si & Fe 0.45; Cu 0.10; Mn 0.10; Mg 2.2-2.8; Cr 0.15-0.35; Zn 0.10	S,W,B,T,R	Sheet metalwork; appliances; bus, truck, and marine uses. Workability and weldability good.
5056*	Si 0.30; Fe 0.40; Cu 0.10; Mn 0.05-0.20; Mg 4.5-5.6; Cr 0.05-0.20; Zn 0.10	W,R	High strength aluminum wire, rivets, staple wire, zippers.
Alclad 5056	(same as above)	W,R	Insect screen cloth.
5083	Si 0.40; Fe 0.40; Cu 0.10; Mn 0.30-1.0; Mg 4.0-4.9; Cr 0.05-0.25; Zn 0.25; Ti 0.15	S,B,E,R	High strength welded structures, tanks, marine uses.
5086	Si 0.40; Fe 0.50; Cu 0.10; Mn 0.20-0.7; Mg 3.5-4.5; Cr 0.05-0.25; Zn 0.25; Ti 0.15	S,B,E,R	Structural alloy with good weldability. Trailer tanks, unfired pressure vessels, towers, elevator cars and truck frames, marine applications.
5154*	Si & Fe 0.45; Cu 0.10; Mn 0.10; Mg 3.1-3.9; Cr 0.15-0.35; Zn 0.20; Ti 0.20	S,W,B,E,T,R	Pressure vessels, marine uses. High strength welding wire.
5254*	Si & Fe 0.45; Cu 0.05; Mn 0.01; Mg 3.1-3.9; Cr 0.15-0.35; Zn 0.20; Ti 0.05	S,W,B,T,R	High purity version of 5154. Special uses in the chemical industry.
5356*	Si & Fe 0.50; Cu 0.10; Mn 0.05-0.20; Mg 4.5-5.5; Cr 0.05-0.20; Zn 0.10; Ti 0.06-0.20	W	Welding wire.
5357	Si 0.12; Fe 0.17; Cu 0.20; Mn 0.15-0.45; Mg 0.8-1.2	S	Refrigerator parts, builders' hardware, automotive trim.
5454	Si & Fe 0.40; Cu 0.10; Mn 0.50-1.0; Mg 2.4-3.0; Cr 0.05-0.20; Zn 0.25; Ti 0.20	S,B,E,T,R	Strong welded structures which operate at slightly elevated temperatures. Tanks, tubes, pipes.
5456	Si & Fe 0.40; Cu 0.10; Mn 0.50-1.0; Mg 4.7-5.5; Cr 0.05-0.20; Zn 0.25; Ti 0.20	S,B,E,R	Uses same as 5083. Available as welding filler wire.
5457	Si 0.08; Fe 0.10; Cu 0.20; Mn 0.15-0.45; Mg 0.8-1.2; others 0.03 each, total 0.10	S	Used for trim on autos. Takes a bright anodized finish.
5652*	Si & Fe 0.40; Cu 0.04; Mn 0.01; Mg 2.2-2.8; Cr 0.15-0.35; Zn 0.10	S,W,B,T,R	High purity version of 5052. Special uses in chemical field; tanks for hydrogen peroxide.
6011	Si 0.6-1.2; Fe 1.0; Cu 0.40-0.9; Mn 0.8; Mg 0.6-1.2; Cr 0.30; Ni 0.20; Zn 1.5; Ti 0.20	S,R	Roll formed products such as lamp bases. Venetian blind stock.
6053	Si 45-65% of Mg; Fe 0.35; Cu 0.10; Mg 1.1-1.4; Cr 0.15-0.35; Zn 0.10	W,R	Rivet wire and rivets.
6061	Si 0.40-0.8; Fe 0.7; Cu 0.15-0.40; Mn 0.15; Mg 0.8-1.2; Cr 0.15-0.35; Zn 0.25; Ti 0.15	S,W,B,E,T,F,R	Heavy duty structures where corrosion resistance is needed. Bridge railings, marine uses, furniture.
Alclad 6061	(same as above)	S	Better corrosion resistance and appearance.
6062	Si 0.40-0.8; Fe 0.7; Cu 0.15-0.40; Mn 0.15; Mg 0.8-1.2; Cr 0.04-0.14; Zn 0.25; Ti 0.15	E,T	Alternate for 6061; preferred for extrusions and tubes.
6063	Si 0.20-0.6; Fe 0.35; Cu 0.10; Mn 0.10; Mg 0.45-0.9; Cr 0.10; Zn 0.10; Ti 0.10	E,T	Pipe, railings, builders' hardware, windows, architectural uses, truck and trailer flooring.
6066	Si 0.9-1.8; Fe 0.50; Cu 0.7-1.2; Mn 0.6-1.1; Mg 0.8-1.4; Cr 0.40; Zn 0.25; Ti 0.20	B,E,T,F,R	Trailer and aircraft structures. Strength and corrosion resistance between 6061 and 2024.
6101*	Si 0.30-0.7; Fe 0.50; Cu 0.10; Mn 0.03; Mg 0.35-0.8; Cr 0.03; Zn 0.10; B 0.06; others 0.03 each, total 0.10	B,E,T,R	High strength bus conductor.
6151	Si 0.6-1.2; Fe 1.0; Cu 0.35; Mn 0.20; Mg 0.45-0.8; Cr 0.15-0.35; Zn 0.25; Ti 0.15	F	Intricate forgings for machine and automotive parts.
6951	Si 0.20-0.50; Fe 0.8; Cu 0.15-0.40; Mn 0.10; Mg 0.40-0.8; Zn 0.20	S,W,B,E,T	Brazed heat exchangers and cooling systems.
7001	Si 0.35; Fe 0.40; Cu 1.6-2.6; Mn 0.20; Mg 2.6-3.4; Cr 0.18-0.40; Zn 6.8-8.0; Ti 0.20	E,T,R,B	High strength alloy for aircraft structures.
7072	Si & Fe 0.7; Cu 0.10; Mn 0.10; Mg 0.10; Zn 0.8-1.3	W	Metallizing wire for sprayed, corrosion resistant coatings. Cladding alloy.
7075	Si 0.50; Fe 0.7; Cu 1.2-2.0; Mn 0.30; Mg 2.1-2.9; Cr 0.18-0.40; Zn 5.1-6.1; Ti 0.20	S,W,B,E,F,T,R	Aircraft structures and keys. High strength alloy.
Alclad 7075	(same as above)	S	Improved corrosion resistance over 7075.
7076	Si 0.40; Fe 0.6; Cu 0.30-1.0; Mn 0.30-0.8; Mg 1.2-2.0; Zn 7.0-8.0; Ti 0.20	F	Forgings, propeller blades.
7079	Si 0.30; Fe 0.40; Cu 0.40-0.8; Mn 0.10-0.30; Mg 2.9-3.7; Cr 0.10-0.25; Zn 3.8-4.8; Ti 0.10	E,F	Similar to 7075; preferred for heavy sections.
7178	Si 0.50; Fe 0.7; Cu 1.6-2.4; Mn 0.30; Mg 2.4-3.1; Cr 0.18-0.40; Zn 6.3-7.3; Ti 0.20	S,B,E,R	Very high strength structural alloy; aircraft applications.
Alclad 7178	(same as above)	S	Increased corrosion resistance over 7178.

(Continued on Page S-26)

ALUMINUM WROUGHT ALLOYS (continued)

Aluminum Assn. Designation	Chemical Composition % max or range, Al remainder	Commercial Forms	Properties and Applications
7277	Si 0.50; Fe 0.7; Cu 0.8-1.7; Mg 1.7-2.3; Cr 0.18-0.35; Zn 3.7-4.3; Ti 0.10	Rivets and rivet rod	Large rivets that are hot driven. High strength applications.

NOTE: Other metals allowed for each alloy—each 0.05, total 0.15, except where noted.
*Be 0.0008 max for welding electrode and filler wire only.
Commercial forms: S—Sheets and plates. W—Wire. E—Extrusions. B—Bars. T—Tubes and pipe. F—Forgings and forging stock. R—Rods.

Source: The Aluminum Association.
**Other alloys for impact extrusions: 2014, 6061, 6151.

ALUMINUM CASTING ALLOYS

Alloy	Composition Limits % max or range; Al remainder	Properties and Uses by Casting Type
12 (112 or 113) ASTM CS72A SAE 33; F 720	Cu 6.0-8.0; Fe 1.4; Si 1.0-4.0; Mn 0.6; Mg 0.10; Zn 2.5; Ti 0.25; Ni 0.35; others 0.50	Fair castability and good machinability. Early general purpose alloy. *Permanent Mold:* Vacuum cleaner housings, general purpose castings. *Sand:* Transmission housings, cover plates, manifolds, and miscellaneous machined castings.
13 ASTM S12B SAE 305; AN-B160 F 0120; A 2312; Ap 13	Cu 0.6; Fe 1.3; Si 11.0-13.0; Mn 0.35; Mg 0.10; Zn 0.35; Ni 0.50; Sn 0.15; others 0.25	Excellent castability with good corrosion resistance. Good mechanical properties. General purpose alloy for large intricate parts with thin sections. *Die:* Typewriter frames, outboard motor pistons, dental equipment, instrument cases.
Ap Z33	Cu 2.5-3.5; Si 4.5-5.5; Mg 0.10; Zn 2.5-3.5; Fe 1.0; Mn 0.50; others 0.50	Good machinability, fair castability. Takes high polish. Similar to Z50. *Sand:* Houshold appliances, automotive, and miscellaneous machined parts.
Ap Z39	Cu 3.5-4.5; Si 8.5-9.5; Mg 0.1; Zn 1.5-2.5; Fe 1.2; Mn 0.5; Ni 0.5; others 0.4 each	Good castability and excellent machinability. *Die:* Automatic transmission impellers and housings, toys, brackets, and other castings where machining is required.
39-11 ASTM SC114A; ADCI-M3-60	Cu 3.0-4.5; Fe 1.3; Si 10.5-12.0; Mn 0.50; Mg 0.10; Zn 1.0; Ni 0.50; Sn 0.35; other (total) 0.50	Good fluidity for intricate, thin walled castings.
43 ASTM S5C SAE 35, 304 F 050; A 2314; Ap 43	Cu 0.15; Fe 0.8; Si 4.5-6.0; Mn 0.35; Mg 0.05; Zn 0.35; Ti 0.25; others 0.05 each	Excellent castability and pressure tightness; good weldability and ductility, good corrosion resistance. *Permanent Mold:* Carburetor bodies, refrigerator shelf brackets and fittings, cooking utensils. *Sand:* Architectural and ornamental parts, pipe fittings, cooking utensils, food handling equipment, and marine fittings. *Die:* Cookware, marine fittings.
Ap Z50	Cu 4.0-5.0; Si 2.5-3.5; Mg 0.07; Zn 1.5-2.5; Fe 1.0; Mn 0.6; Ni 0.3	Good machinability, fair castability. Takes high polish. *Sand:* Household appliances, automotive, and miscellaneous machined parts.
108 ASTM CS43A; AN 6265	Cu 3.5-4.5; Fe 1.2; Si 2.5-3.5; Mn 0.50; Mg 0.10; Zn 1.0; Ti 0.25; Ni 0.35; others 0.50	General purpose alloy with fair castability. *Sand:* Manifolds, valve bodies, and similar castings.
A108 ASTM SC64A SAE 330 AN-6265	Cu 4.0-5.0; Fe 0.8; Si 5.0-6.0; Mn 0.10; Mg 0.10; Zn 0.10; Ti 0.20; others 0.30	Castings requiring pressure tightness and moderate strength. *Permanent Mold:* Ornamental grilles, reflectors, and general purpose castings.
122 ASTM CG100A SAE 34	Cu 9.2-10.8; Fe 1.2; Si 1.0; Mn 0.10; Mg 0.20-0.35; Zn 0.10; Ni 0.10; Ti 0.20; others 0.30	Retains strength at elevated temperatures. *Sand:* Air cooled cylinder heads. Solution heat treated and aged for bearings, bushings, tappet guides.
A132 ASTM SN122A SAE 321 F 1121 Ni; AN 162	Cu 0.50-1.5; Fe 1.3; Si 11.0-13.0; Mn 0.35; Mg 0.7-1.3; Zn 0.35; Ti 0.25; Ni 2.0-3.0; others 0.05	Good high temperature properties at 500 to 600° F. Low coefficient of thermal expansion. Weldability good. *Permanent Mold:* Pulleys, sheaves, automotive, and diesel pistons.
F132 ASTM SC103A; AN-B143 SAE 332; Ap 34	Cu 2.0-4.0; Fe 1.2; Si 8.5-10.5; Mn 0.50; Mg 0.5-1.5; Zn 1.0; Ni 0.50; Ti 0.25; others 0.5	Similar to A132 but with better castability and machinability.
138 ASTM CS104A F 1040.3; Ap 38	Cu 9.0-11.0; Fe 1.5; Si 3.5-4.5; Mn 0.6; Mg 0.15-0.35; Zn 1.5; Ti 0.25; Ni 1.0; others 0.50	High as-cast hardness; good castability and good machinability. *Permanent Mold:* Sole plates for electric hand irons.
142 (Y-alloy) ASTM CN 42A SAE 39; AN 218 A142; F 401.5 Ni; Ap 59	Cu 3.5-4.5; Fe 1.0; Si 0.7; Mn 0.35; Mg 1.2-1.8; Zn 0.35; Cr 0.25; Ti 0.25; Ni 1.7-2.3; others 0.15	Good strength at elevated temperatures. *Permanent Mold:* Aircraft generator housings, diesel and aircraft pistons, air cooled cylinder heads. *Sand:* Diesel engine pistons and air cooled cylinder heads.
Ap Red X 8 ASTM SC 82A SAE 327	Cu 1.0-2.0; Si 7.0-8.5; Mg 0.2-0.6; Zn 1.0; Cr 0.3; Fe 1.0; Mn 0.2-0.6; others 0.2 each	Castability and mechanical properties good. Rugged, tough alloy for extreme applications. *Sand:* Cylinder blocks, crankcases, supercharger housings, and general automotive use.
Ap Red X 11 ASTM SC 122A	Cu 1.0-2.0; Si 10.5-11.8; Mg 0.4-1.0; Zn 1.0; Fe 0.9; Mn 0.5-0.9; others 0.2 each	Good castability with low coefficient of expansion. *Permanent Mold:* Automotive pistons and similar applications.
Ap Red X 20	Cu 1.0-2.0; Si 19-22; Mg 0.4-1.0; Mn 0.2-0.6; Ni 0.3-1.0; Fe 0.8; Zn 1.0	Excellent wear resistance, low coefficient of thermal expansion. *Sand, Permanent Mold,* and *Die:* Cylinders, liners, brakes, precision instruments.
152 Ap 66; SAE 300 ASTM CS66A	Cu 5.5-7.5; Fe 1.5; Si 5.0-6.0; Mn 0.8; Mg 0.20-0.6; Zn 0.8; Ti 0.25; others 0.8	Good elevated temperature strength and good machinability. *Permanent Mold:* Automotive pistons.
195 ASTM C4A; AN 225 SAE 38; F 410; Ap 52	Cu 4.0-5.0; Fe 1.0; Si 1.5; Mn 0.35; Mg 0.03; Zn 0.35; Ti 0.25; others 0.15	Castability fair with good machining properties. Good balance of mechanical properties for parts needing strength and ruggedness. *Sand:* Flywheel and rear axle housings, bus and aircraft wheels, spring hangers, fittings, crankcases; usually heat treated.
B195 ASTM CS42A SAE 380; AN 224	Cu 4.0-5.0; Fe 0.8; Si 2.0-3.0; Mn 0.10; Mg 0.03; Zn 0.10; Ti 0.20; others 0.15	*Permanent Mold:* Aircraft fittings, aircraft gun control parts, aircraft wheels, railroad car seat frames, fuel pump bodies, aircraft gear housings.
212	Cu 7.0-8.5; Fe 1.2; Si 1.0-1.5; Mn 0.10; Mg 0.05; Zn 0.10; Ti 0.20; others 0.30	Improved foundry characteristics over 112 alloy and less hot short. *Sand:* Generally used interchangeably with 112 for applications such as housings, cover plates.
214 ASTM G4A SAE 320; F 004; Ap 414	Cu 0.15; Fe 0.50; Si 0.35; Mn 0.35; Mg 3.5-4.5; Zn 0.15; Ti 0.25; others 0.15	Castability poor; good balance of mechanical properties. Excellent corrosion and tarnish resistance. Good alloy for anodizing. *Sand:* Dairy and food handling equipment, cooking utensils, fittings for chemical and sewage use, hardware, and ornamental housings.
A214 ASTM GZ42A AN 322	Cu 0.10; Fe 0.30; Si 0.30; Mn 0.10; Mg 3.6-4.5; Zn 1.4-2.2; Ti 0.20; others 0.15	Good resistance to corrosion and tarnishing. *Permanent Mold:* Cooking utensils, architectural fittings.
B214 ASTM GS42A AN 321	Cu 0.10; Fe 0.30; Si 1.4-2.2; Mn 0.10; Mg 3.6-4.5; Cr 0.10; Zn 0.10; Ti 0.20; others 0.15	Improved foundry characteristics over 214 alloy but somewhat lower mechanical properties. *Sand:* Excellent resistance to corrosion.
F214 AN-A 320	Cu 0.10; Fe 0.30; Si 0.30-0.7; Mn 0.10; Mg 3.6-4.5; Zn 0.10; Ti 0.20; others 0.15	Modification of 214 alloy providing improved foundry characteristics with more uniform appearance after Alumilite treatment. *Sand:* Ornamental hardware and architectural castings requiring Alumilliting.
L214	Cu 0.10; Fe 0.6-0.9; Si 0.50-1.0; Mn 0.40-0.6; Mg 2.6-4.0; Ni 0.10; Zn 0.10; Sn 0.10; others 0.15	Good corrosion resistance. *Die:* Hardware, support brackets.
218 ASTM G8A; AN 6204 F 008; Ap 418	Cu 0.25; Fe 1.8; Si 0.35; Mn 0.35; Mg 7.5-8.5; Zn 0.15; Ni 0.15; Sn 0.15; others 0.25	Good resistance to corrosion and tarnish. Excellent strength and ductility. Good for anodizing. *Die:* Parts requiring high strength, ductility and corrosion resistance, such as aircraft and marine fittings, conveyor units, hardware. Not best for intricate parts due to poor castability.

ALUMINUM CASTING ALLOYS (continued)

Alloy	Composition Limits % max or range; Al remainder	Properties and Uses by Casting Type
220 ASTM G10A SAE 324; F 0010; Ap 420; AN 6080	Cu 0.25; Fe 0.30; Si 0.25; Mn 0.15; Mg 9.5-10.6; Zn 0.15; Ti 0.25; others 0.15	Requires special foundry practice. Highest strength and elongation of any sand casting alloy when heat treated. Good machinability and corrosion resistance. *Sand:* Parts requiring strength and shock resistance: Aircraft fittings, levers, brackets. Not for use above 250° F.
319 ASTM SC64C SAE 329; AN 6145	Cu 3.0-4.5; Fe 1.2; Si 5.5-7.0; Mn 0.8; Mg 0.50; Zn 1.0; Ti 0.25; Ni 0.50; others 0.50	Excellent castability with good mechanical properties. *Sand:* Piano plates and frames, engine crankcases, oil pans, rear axle housings requiring leak tightness, general purpose uses.
A319 Ap Alicast 70 ASTM SC64D SAE 326 F 460; Al 2364	Cu 3.3-4.3; Fe 1.0; Si 5.5-7.0; Mn 0.50; Mg 0.10; Zn 1.0; Ti 0.25; Ni 0.35; others 0.50	Excellent castability, good mechanical properties. Pressure tightness good. *Sand:* Engine crankcases, oil pans, automatic transmission housings. *Permanent Mold:* Typewriter frames, engine parts.
333	Cu 3.0-4.5; Fe 1.2; Si 8.0-10.0; Mn 0.8; Mg 0.6; Zn 1.0; Ni 0.5; Ti 0.2; others 0.50	Excellent casting characteristics with good mechanical properties. *Permanent Mold:* General purpose castings, engine parts, gas meter housings and regulator parts.
355 ASTM SC51A SAE 322; AN 125 F 150.5; Ap 41	Cu 1.0-1.5; Fe 0.6; Si 4.5-5.5; Mn 0.50; Mg 0.45-0.60; Zn 0.35; Cr 0.25; Ti 0.25; others 0.15	Castability and weldability good. Pressure tightness good. Parts usually heat treated. *Permanent Mold:* Aircraft supercharger covers, impellers, fittings, and timing gears. Meter parts and fuel pump bodies. *Sand:* Air compressor pistons, printing press bed plates, crankcases, water jackets, gear housings, electric motor fans and blowers. Widely used. A355 parts used at elevated temperatures.
C355; Ap HP41 ASTM SC51B AN-B125	Cu 1.0-1.5; Fe 0.15; Si 4.5-5.5; Mn 0.05; Mg 0.45-0.6; Zn 0.05; Ti 0.08-0.20; others 0.10	Same as 355 alloy but having greater elongation. *Sand:* Same as for 355 alloy.
D355	Cu 1.0-1.5; Fe 0.10; Si 4.5-5.5; Mn 0.05; Mg 0.45-0.6; Zn 0.05; Ti 0.08-0.20; others 0.10	Same as 355 alloy but having less Fe. *Sand:* Same as for 355 alloy.
356 ASTM SG70A SAE 323 Ap 46; A 2356, 2370; F 070.3	Cu 0.25; Fe 0.60; Si 6.5-7.5; Mn 0.35; Mg 0.20-0.40; Zn 0.35; Ti 0.25; others 0.15	Castability and weldability good. Good pressure tightness and resistance to corrosion. Parts usually heat treated. *Permanent Mold:* Machine tool parts, hand-wheels, aircraft pump parts. *Sand:* Automotive transmission cases, flywheel housings, oil pans, rear axle housings, brackets, fittings, and pump bodies.
A356 Ap HP46 ASTM SG70B AN-B 135	Cu 0.10; Fe 0.12; Si 6.5-7.5; Mn 0.05; Mg 0.25-0.40; Zn 0.05; Ti 0.08-0.20; others 0.10	Same as 356 alloy but having greater elongation. *Sand:* Same as for 356 alloy.
B356	Cu 0.10; Fe 0.10; Si 6.5-7.5; Mn 0.05; Mg 0.25-0.40; Zn 0.05; Ti 0.08-0.20; others 0.10	Same as 356 alloy but less Fe. *Sand:* Same as for 356 alloy.
357; A 2357	Cu 0.05; Si 7.0; Mg 0.5; Fe 0.15	High strength and good ductility after heat treatment. *Sand* and *Permanent Mold:* Highly stressed aircraft and missile structures, high velocity blowers and impellers.
358	Cu 0.10; Fe 0.12; Si 6.5-7.5; Mn 0.05; Mg 0.45-0.7; Zn 0.05; Ti 0.08-0.20; Be 0.05-0.12; others 0.10	High strength and good ductility after heat treatment. *Sand and Permanent Mold:* Aircraft pump parts, machine tool parts.
364	Cu 0.20; Fe 1.5; Si 7.5-9.5; Mn 0.10; Mg 0.20-0.40; Zn 0.15; Ni 0.15; Cr 0.25-0.50; Be 0.02-0.04; others 0.15	Excellent castability and mechanical properties. *Die:* High ductility castings where resistance to impact is important.
Ap Ternalloy 5 ASTM ZG32A SAE 311; R 403	Cu 0.20; Si 0.20; Mg 1.4-1.8; Zn 2.7-3.3; Cr 0.20-0.40; Fe 0.8; Mn 0.4-0.6; Ti 0.25; others 0.05 each	High strength and good elongation without heat treatment. Exceptional dimensional stability. Good brazing and welding alloy. *Sand:* Pipe fittings, wrenches, farm machinery, machine tool equipment, high pressure valves, and other high strength uses. *Permanent Mold:* Street lighting equipment, heavy duty brackets, tooling equipment, precision gages, castings for electronics.
Ap Ternalloy 7 ASTM ZG42A SAE 312	Cu 0.20; Si 0.20; Mg 1.8-2.4; Zn 4.0-4.5; Fe 0.8; Mn 0.40-0.60; Cr 0.20-0.40; Ti 0.25; others 0.05 each	Same as above but for parts needing less elongation and higher yield strength. *Sand* and *Permanent Mold:* Can be heat treated to high strength.
360 ASTM SG100B SAE 309; F 090.5; Ap 36	Cu 0.6; Fe 1.3; Si 9.0-10.0; Mn 0.35; Mg 0.40-0.60; Zn 0.50; Ni 0.50; Sn 0.15; others 0.25	Excellent castability. Mechanical properties and corrosion resistance good. *Die:* Aircraft, marine, and outboard motor parts, general purpose castings.
380; ASTM-SC 84B Ap 39; F 480; AN 6233 SAE 306	Cu 3.0-4.0; Fe 1.3; Si 7.5-9.5; Mn 0.50; Mg 0.10; Zn 1.0; Ni 0.50; Sn 0.35; others 0.50	Castability and mechanical properties good. Good machinability. *Die:* General purpose parts. Most widely used diecasting alloy.
382	Cu 0.10; Fe 0.40; Si 3.0-4.0; Mn 0.10; Mg 1.7-2.5; Cr 0.10; Ti 0.20; others 0.15	Good castability and resistance to corrosion; excellent machinability. *Permanent Mold:* Cooking utensils, pipe fittings, and architectural parts.
Ap Z39	Same as 380, but Zn 3.0	Good castability, excellent machinability. *Die:* General purpose, replacing 380.
384 ASTM SC114A Ap 39-11 SAE 303	Cu 3.0-4.5; Fe 1.3; Si 10.5-12.0; Mn 0.50; Mg 0.10; Zn 1.0	Excellent for thin walls. *Die:* Wringer frames, toys, automatic transmissions, general purpose thin wall castings.
407	Cu 0.20; Fe 0.6; Si 0.20; Mn 0.40-0.6; Mg 1.9-2.4; Cr 0.20-0.40; Zn 4.0-4.5; Ti 0.25; others 0.15	High strength and ductility without heat treatment. *Permanent Mold:* Used for castings requiring brazing.
Ap 417; R-A218 Almag ASTM GM70B	Cu 0.10; Si 0.20; Mg 6.2-7.5; Fe 0.25; Mn 0.10-0.25; Ti 0.10-0.25; others 0.05 each	High strength, exceptional ductility; good anodizing characteristics and machinability. *Sand:* C-clamps, brackets and machined parts requiring strength, machinability, corrosion resistance, polishing, and anodizing. *Permanent Mold:* Impellers, optical equipment needing high polish or anodized finish.
A612 ASTM ZG61B SAE 313; AN 432	Cu 0.35-0.65; Fe 0.50; Si 0.15; Mn 0.05; Mg 0.6-0.8; Zn 6.0-7.0; Ti 0.25; others 0.15	High strength and ductility without heat treatment. Good machinability. *Sand:* General purpose castings, particularly for brazing.
C612 ASTM ZC60A SAE 314	Cu 0.35-0.65; Fe 1.4; Si 0.35; Mn 0.05; Mg 0.25-0.45; Zn 6.0-7.0; Ti 0.25; others 0.15	High strength and ductility without heat treatment. Good machinability. *Permanent Mold:* Torque converter impeller blades and furniture parts requiring brazing.
F Tenzaloy; R613 ASTM ZC81A-B	Cu 0.40-1.0; Fe 1.0; Si 0.25; Mn 0.6; Mg 0.20-0.50; Zn 7.0-8.0; Cr 0.35; Ti 0.25; Ni 0.15; others 0.25	High strength without heat treatment. Ages at room temperature to give properties of heat treated castings. *Permanent Mold:* Machine tool frames, high speed fan rotors. *Sand:* Housings for hoists and other heavy duty equipment. Street signs and brackets. Excellent machinability, easily brazed.
40E; R405 ASTM ZG61A SAE 310	Cu 0.30; Fe 1.0; Si 0.25; Mn 0.30; Mg 0.50-0.65; Zn 5.2-6.0; Cr 0.40-0.60; Ti 0.10-0.25; others 0.25	Good mechanical properties without heat treatment. Good resistance to corrosion and shock. *Sand:* Aircraft and instrument parts subject to shock.
750 Ap 700; AN 6044	Cu 0.7-1.3; Fe 0.7; Mn 0.10; Si 0.7; Ni 0.7-1.3; Ti 0.20; Sn 5.5-7.0; others 0.30	Excellent bearing qualities with good compressive yield strength. *Permanent Mold* and *Sand:* Bearings, bushings, and parts needing bearing properties.
A750	Cu 0.7-1.3; Fe 0.7; Si 2.0-3.0; Mn 0.10; Ni 0.30-0.7; Ti 0.20; Sn 5.5-7.0; others 0.30	Better casting characteristics, less hot-short than 750 alloy. *Sand and Permanent Mold:* Large rolling mill bearings.
B750	Cu 1.7-2.3; Fe 0.7; Si 0.40; Mn 0.10; Mg 0.6-0.9; Ni 0.9-1.5; Ti 0.20; Sn 5.5-7.0; others 0.30	Higher compressive strength than 750 alloy. *Permanent Mold:* Small, heavily loaded bearings and bushings.
F Adaptaloy	Cu 2.0; Mn 1.0	Highly ductile alloy. Useful for castings that must be cold formed for assembly operation. Tensile, yield, and hardness are comparable to the 43 alloy.

Key to Producers' Trade Names: AN—Alcan-Aluminium Ltd. Sales Inc. Ap—Apex Smelting Co. F—Federated Metals Div., American Smelting & Refining Co. R—Reynolds Metals Co.

ZINC DIECASTING ALLOYS

ASTM, SAE Number, and Commercial Name	Composition Limits % ASTM B86-57T Specification	Properties and Applications
AG40A SAE-903 Zamak-3	Cu 0.25 max; Al 3.5-4.3; Mg 0.03-0.08; Fe 0.100 max; Pb 0.007 max; Cd 0.005 max; Sn 0.005 max	Retention of impact strength and dimensions. Used where stability is important. Carburetors, fuel pumps, refrigerator hardware, washing machines, parking meters, television, any of below.
AC41A SAE-925 Zamak-5	Cu 0.75-1.25; Al 3.5-4.3; Mg 0.03-0.08; Fe 0.100 max; Pb 0.007 max; Cd 0.005 max; Sn 0.005 max	Greater hardness and tensile strength. Used where hardness is important. Business machines, gears, cams, hardware, lawn mowers, fans, small tools, any of above.

NOTE: For most commercial applications, copper in the range of 0.25 and 0.75 per cent is tolerable.

ZIRCONIUM

Material	Nominal Composition %	Properties and Applications
Commercial Grade Grade 11 Grade 12	Zr plus Hf 99.5 (Hf 2)	Ductile and formable, weldable. Grade 11 has 64,000 psi tensile, grade 12 is 60,000 but withstands corrosion under more severe conditions. Used for chemical processing equipment, heat exchangers. Resists acids except hydrofluoric.
Reactor Grade Grade 21	Hf 200 ppm max	Low thermal neutron cross section for nuclear applications, in liquid metal cooled and fast breeder reactors. Flashbulb filler material, surgical implants.
Zircalloy 2 Grade 32	Sn 1.5; Cr 0.1; Fe 0.13; Ni 0.05	Resists corrosion by hot water and steam; small neutron cross section. Specifications: MIL-Z-19859A; ASTM B 350-60T, B 351-60T, B 352-60T, B 353-60T.
Zircalloy 4 Grade 34	Sn 1.5; Cr 0.10; Fe 0.13-0.24; Ni 0.007 max	Similar to Zircalloy 2, less hydrogen pickup.
Grade 41	Cu 0.5; Mo 0.5	70,000 psi tensile, resistant to wet and dry CO_2, good high temperature strength.
Grade 42	Cu 1.09; Mo 1.5	80,000 psi tensile, similar to Grade 41.

HIGH STRENGTH STEELS

Name	Producer	Chemical Composition Limits, Per Cent C	Mn	P	S	Si	Cu	Mo	Cr	Ni	Others	Yield Point Min psi	Tensile Strength Min psi	Min % Elongation in 2 in. for Stand. ASTM Spec.
Algo-Loy 1315	Algoma Steel Corp. Ltd.	0.10–0.20	1.10–1.65	0.045 max	0.050 max	0.15–0.35	0.40 max	.....	.....	.....	.....	50,000	70,000	22
Algo-Loy 1317	Algoma Steel Corp. Ltd.	0.25 max	1.65 max	0.045 max	0.050 max	0.35 max	0.20 min	0.05 max	0.30 max	0.30 max	.....	50,000	70,000	20
AL-TEN*	Alan Wood Steel Co.	0.16	0.75	.....	.....	0.04	0.25	.....	.....	.....	Columbium 0.02	50,000	70,000	18**
AWX 45*	Alan Wood Steel Co.	0.16	0.60	.....	.....	0.04	.....	.....	.....	.....	Columbium 0.02	45,000	63,000	20**
AWX 50*	Alan Wood Steel Co.	0.16	0.60	.....	.....	0.04	.....	.....	.....	.....	Columbium 0.02	50,000	67,000	18**
Clay-Loy	Phoenix Steel Corp.	0.22 max	1.25 max	0.05 max	0.05 max	0.35 max	0.50 max	.....	.....	.....	V 0.2 min	50,000	70,000	..
Cor-Ten	(2)	0.12 max	0.20–0.50	0.07–0.15	0.05 max	0.25–0.75	0.25–0.55	.....	0.30–1.25	0.65 max	.....	50,000	70,000	22
Dynalloy 50	Alan Wood Steel Co.	0.15 max	0.60–1.40	0.050–0.100	0.050 max	0.30 max	0.30–0.60	0.05–0.15	.....	0.40–0.70	.....	50,000	70,000 (Under ½")	22
"e.t.d." 180 (7)	LaSalle Steel Co.	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	165,000	180,000	5–10
"e.t.d." 150 (7)	LaSalle Steel Co.	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	130,000	150,000	10–20
EX-TEN 45*	United States Steel Corp.	0.26 max	1.50 max	0.04 max	0.05 max	.....	.....	.....	.....	.....	Cb 0.01–0.04	45,000	60,000	25
EX-TEN 50*	United States Steel Corp.	0.26 max	1.50 max	0.04 max	0.05 max	.....	.....	.....	.....	.....	Cb 0.01–0.04	50,000	65,000	22
EX-TEN 55*	United States Steel Corp.	0.26 max	1.50 max	0.04 max	0.05 max	.....	.....	.....	.....	.....	Cb 0.01–0.04	55,000	70,000	20
EX-TEN 60*	United States Steel Corp.	0.26 max	1.50 max	0.04 max	0.05 max	.....	.....	.....	.....	.....	Cb 0.01–0.04	60,000	75,000	18
Fatigue-Proof	LaSalle Steel Co.	0.40–0.48	1.35–1.65	0.040 max	0.24–0.33	0.15–0.30	.....	.....	.....	.....	.....	125,000	140,000	5–15
GLX-45-W	Great Lakes Steel Corp., Weirton Steel Co.	0.10–0.20	0.50–1.00	0.04 max	0.05 max	0.10 max	.....	.....	.....	.....	Cb 0.01–0.04	45,000	65,000	22
GLX-50-W	Great Lakes Steel Corp., Weirton Steel Co.	0.10–0.20	0.50–1.00	0.04 max	0.05 max	0.10 max	.....	.....	.....	.....	Cb 0.01–0.04	50,000	70,000	22
GLX-55-W	Great Lakes Steel Corp., Weirton Steel Co.	0.10–0.20	0.50–1.00	0.04 max	0.05 max	0.10 max	.....	.....	.....	.....	Cb 0.01–0.04	55,000	75,000	22
GLX-60-W	Great Lakes Steel Corp., Weirton Steel Co.	0.10–0.20	0.50–1.00	0.04 max	0.05 max	0.10 max	.....	.....	.....	.....	Cb 0.01–0.04	60,000	80,000	22
Hi-Man	Inland Steel Co.	0.25 max	1.10–1.60	0.045 max	0.05 max	0.30 max	0.20 min	.....	.....	.....	.....	50,000	75,000	20
Hi-Man 440 (ASTM A-440)	Inland Steel Co.	0.28 max	1.10–1.60	0.04 max	0.05 max	0.30 max	0.20 min	.....	.....	.....	.....	50,000	70,000	..
Hi-Steel	Inland Steel Co.	0.12 max	0.50–1.00	0.12 max	0.05 max	0.15 max	0.55–1.30	0.18 max	.....	0.30–0.75	.....	50,000	70,000	22 (1)
High Strength #1	Armco Steel Corp.	0.15 max	0.40–0.95	0.04–0.07	0.04 max	0.15 max	0.50–0.75	.....	.....	0.60–0.90	.....	50,000	70,000	22
High Strength #2	Armco Steel Corp.	0.15 max	0.40–0.95	0.04–0.07	0.04 max	0.15 max	0.50–0.75	.....	.....	0.60–0.90	.....	45,000 typ.	64,000 typ.	..
High Strength #3	Armco Steel Corp.	0.10 max	0.30–0.90	0.04 max	0.05 max	0.10 max	0.20 max	.....	.....	.....	V 0.02 min	40,000 typ.	60,000 typ.	35 typ.
High Strength #4	Armco Steel Corp.	0.25 max	1.10–1.60	0.045 max	0.05 max	0.15–0.35	0.20 min	.....	.....	.....	.....	50,000	70,000	22

High Strength #5	Armco Steel Corp.	0.22 max	1.25 max	0.04 max	0.05 max	0.30 max	0.20 min	.....	.....	.....	V 0.02 min	45,000	60,000	25
High Strength #6	Armco Steel Corp.	0.17 typ.	0.70 typ.	.....	.....	.....	.....	.....	.....	.....	Cb 0.02 typ.	50,000	70,000	22
High Strength #7	Armco Steel Corp.	0.13 typ.	0.70 typ.	.....	.....	.....	.....	.....	.....	.....	Cb 0.02 typ.	45,000	65,000	22
INX-45*	Inland Steel Co.	0.20 max	1.00 max	0.04 max	0.05 max	0.10 max	.....	.....	.....	.....	Cb 0.005 min	45,000	60,000	..
INX-50*	Inland Steel Co.	0.22 max	1.10 max	0.04 max	0.05 max	0.10 max	.....	.....	.....	.....	Cb 0.005 min	50,000	65,000	..
INX-55*	Inland Steel Co.	0.24 max	1.40 max	0.04 max	0.05 max	0.30 max	.....	.....	.....	.....	Cb 0.005 min	55,000	70,000	..
INX-60*	Inland Steel Co.	0.26 max	1.60 max	0.04 max	0.05 max	0.30 max	.....	.....	.....	.....	Cb 0.005 min	60,000	75,000	..
Jalloy-AR 360*	Jones & Laughlin Steel Corp.	0.25–0.31	1.35–1.65	0.04 max	0.04 max	0.15–0.30	.....	0.10–0.20	0.20 min	.....	.....	.....	.....	..
Jalloy-AR 400*	Jones & Laughlin Steel Corp.	0.25–0.31	1.35–1.65	0.04 max	0.04 max	0.15–0.30	.....	0.10–0.20	0.20 min	.....	.....	.....	.....	..
Jalloy-S-90	Jones & Laughlin Steel Corp.	0.10–0.20	1.10–1.50	0.040 max	0.04 max	0.15–0.30	.....	0.20–0.30	.....	.....	.....	90,000	105,000	18 (4)
Jalloy-S-100	Jones & Laughlin Steel Corp.	0.10–0.20	1.10–1.50	0.040 max	0.04 max	0.15–0.30	.....	0.20–0.30	.....	.....	.....	100,000	115,000	18 (4)
Jalloy-S-110	Jones & Laughlin Steel Corp.	0.10–0.20	1.10–1.50	0.040 max	0.04 max	0.15–0.30	.....	0.20–0.30	.....	.....	.....	110,000	125,000	18 (4)
JLX-45-W*	Jones & Laughlin Steel Corp.	0.20 max	0.50–1.00	0.04 max	0.05 max	0.10 max	.....	.....	.....	.....	Cb 0.01 min	45,000	60,000	24
JLX-50-W*	Jones & Laughlin Steel Corp.	0.20 max	0.50–1.00	0.04 max	0.05 max	0.10 max	.....	.....	.....	.....	Cb 0.01 min	50,000	65,000	22
JLX-55-W*	Jones & Laughlin Steel Corp.	0.20 max	0.50–1.00	0.04 max	0.05 max	0.10 max	.....	.....	.....	.....	Cb 0.01 min	55,000	70,000	20
JLX-60-W*	Jones & Laughlin Steel Corp.	0.20 max	0.50–1.00	0.04 max	0.05 max	0.10 max	.....	.....	.....	.....	Cb 0.01 min	60,000	75,000	18
Kaisaloy #1	Kaiser Steel Corp.	0.20 max	1.25 max	0.05 max	0.05 max	0.60 max	0.35 max	0.15 max	0.25 max	0.60 max	V 0.02 min Ti 0.005 min Al 0.25 max	50,000	70,000	23
Kaisaloy #2	Kaiser Steel Corp.	0.12 max	0.60 max	0.04 max	0.04 max	0.50 max	0.30 max	0.10 max	0.25 max	0.60 max	V 0.02 min Ti 0.005 min	45,000	60,000	25
Kaisaloy #3	Kaiser Steel Corp.	0.30 max	1.50 max	0.04 max	0.05 max	0.35 max	0.35 max	0.10 max	0.25 max	0.40 max	V 0.05 min Ti 0.005 min	.....	.....	..
Kaiser Moly-Boron	Kaiser Steel Corp.	0.14 max	0.60 max	0.04 max	0.05 max	0.60 max	.....	0.40–0.60	.....	.....	B 0.0015-0.0035	65,000	75,000	20
Kaiser (Structural High Strength)	Kaiser Steel Corp.	0.27 max	1.60 max	0.045 max	0.05 max	0.30 max	0.20 max	.....	.....	.....	.....	50,000	75,000	18
Manganese Vanadium	Bethlehem Steel Co.	0.22 max	1.25 max	0.04 max	0.05 max	0.30 max	0.20 min	.....	.....	.....	V 0.02 min	50,000	70,000	22
Man-Ten	United States Steel Corp.	0.25 max	1.10–1.60	0.045 max	0.05 max	0.30 max	0.20 min	.....	.....	.....	.....	50,000	75,000	20
Man-Ten (A440)	United States Steel Corp.	0.28 max	1.10–1.60	0.04 max	0.05 max	0.30 max	0.20 min	.....	.....	.....	.....	50,000	70,000	..
Maxeloy	Crucible Steel Co. of America	0.15 max	1.20 max	0.07 max	0.04 max	0.50 max	0.20 min	.....	.....	0.50 max	.....	50,000	70,000	22
Mayari R	Bethlehem Steel Co.	0.12 max	0.50–1.00	0.12 max	0.05 max	0.20–0.90	0.50 max	.....	0.40–1.00	1.00 max	Zr 0.10 max	50,000	70,000	22
Medium Manganese	Bethlehem Steel Co.	0.25 max	1.10–1.60	0.04 max	0.05 max	0.30 max	0.20–0.35	.....	.....	.....	.....	50,000	75,000	20
MIL-S-18729B	Lukens Steel Co.	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	..
N-A-X Finegrain (3)	Great Lakes Steel Corp., Weirton Steel Co.	0.18 max	0.50–1.00	0.04 max	0.05 max	0.50–0.90	0.25 max	.....	.....	.....	Zr 0.05–0.15	50,000	70,000	22
N-A-X High Manganese	Great Lakes Steel Corp.	0.25 max	1.10–1.60	0.045 max	0.05 max	0.30 max	0.20 min	.....	.....	.....	.....	50,000	70,000	22
N-A-X High Tensile	Great Lakes Steel Corp., Weirton Steel Co., Republic Steel Corp., Sharon Steel Corp., Granite City Steel Co. (2)	0.15 max	0.50–1.00	0.04 max	0.05 max	0.60–0.90	0.25 max	0.20 max	0.40–0.70	.....	Zr 0.05–0.15	50,000	70,000	22
N-A-Xtra 80	Great Lakes Steel Corp.	0.10–0.20	0.60–1.00	0.040 max	0.040 max	0.50–0.90	.....	0.15–0.25	0.45–0.85	.....	Zr 0.03–0.15	80,000	95,000	18 (4)
N-A-Xtra 90	Great Lakes Steel Corp.	0.10–0.20	0.60–1.00	0.040 max	0.040 max	0.50–0.90	.....	0.15–0.25	0.45–0.85	.....	Zr 0.03–0.15	90,000	105,000	18 (4)
N-A-Xtra 100	Great Lakes Steel Corp.	0.10–0.20	0.60–1.00	0.040 max	0.040 max	0.50–0.90	.....	0.15–0.25	0.45–0.85	.....	Zr 0.03–0.15	100,000	115,000	18 (4)
N-A-Xtra 110	Great Lakes Steel Corp.	0.10–0.20	0.60–1.00	0.040 max	0.040 max	0.50–0.90	.....	0.15–0.25	0.45–0.85	.....	Zr 0.03–0.15	110,000	125,000	18 (4)
Nickel-Copper-Titanium	Jones & Laughlin Steel Corp.	0.15 max	1.00 max	0.04 max	0.05 max	0.50 max	0.20 min	.....	.....	0.70 max	Ti 0.05 max	50,000	70,000	..
Par-Ten	United States Steel Corp.	0.12 max	0.75 max	0.04 max	0.05 max	0.10 max	.....	.....	.....	.....	V 0.01–0.07	45,000 typ.	62,000 typ.	28 typ.
PITT-TEN #1	Pittsburgh Steel Co.	0.12 max	0.55–0.95	0.07 max	0.05 max	0.20 max	0.60–1.05	.....	.....	0.45–0.95	.....	50,000	70,000	22
PITT-TEN #2	Pittsburgh Steel Co.	0.15 max	0.75 max	0.04 max	0.05 max	0.10 max	.....	.....	.....	.....	V 0.035–0.070	(6)	(6)	(6)
PITT-TEN X-45-W	Pittsburgh Steel Co.	0.10–0.20	0.50–1.00	0.04 max	0.05 max	0.10 max	.....	.....	.....	.....	Cb 0.01–0.04	45,000	60,000	24
PITT-TEN X-50-W	Pittsburgh Steel Co.	0.10–0.20	0.50–1.00	0.04 max	0.05 max	0.10 max	.....	.....	.....	.....	Cb 0.01–0.04	50,000	65,000	22
PITT-TEN X-55-W	Pittsburgh Steel Co.	0.10–0.20	0.50–1.00	0.04 max	0.05 max	0.10 max	.....	.....	.....	.....	Cb 0.01–0.04	55,000	70,000	20
PITT-TEN X-60-W	Pittsburgh Steel Co.	0.10–0.20	0.50–1.00	0.04 max	0.05 max	0.10 max	.....	.....	.....	.....	Cb 0.01–0.04	60,000	75,000	18
Republic "M"	Republic Steel Corp.	0.25 max	1.10–1.60	0.045 max	0.05 max	0.30 max	0.20 min	.....	.....	.....	.....	50,000	75,000	20
Republic "50"	Republic Steel Corp.	0.15 max	0.50–1.00	0.04 max	0.05 max	.....	0.30–1.00	0.10 min	0.30 max	0.40–1.10	.....	50,000	70,000	22
Republic "65"	Republic Steel Corp.	0.15 max	1.00 max	0.04 max	0.04 max	0.15 max	0.90–1.40	0.20–0.30	.....	1.00–1.50	.....	65,000	85,000	20 (4)
Republic "70"	Republic Steel Corp.	0.20 max	1.00 max	0.04 max	0.04 max	0.15 max	1.00–1.50	0.20–0.30	.....	1.20–1.75	.....	70,000	90,000	18 (4)
Republic X-45-W	Republic Steel Corp.	0.20 max	0.50–1.00	0.04 max	0.05 max	0.10 max	.....	.....	.....	.....	Cb 0.01 min	45,000	60,000	22
Republic X-50-W	Republic Steel Corp.	0.20 max	0.50–1.00	0.04 max	0.05 max	0.10 max	.....	.....	.....	.....	Cb 0.01 min	50,000	65,000	22
Republic X-55-W	Republic Steel Corp.	0.25 max	1.50 max	0.04 max	0.05 max	0.10 max	.....	.....	.....	.....	Cb 0.01 min	55,000	70,000	20
Republic X-60-W	Republic Steel Corp.	0.25 max	1.50 max	0.04 max	0.05 max	0.10 max	.....	.....	.....	.....	Cb 0.01 min	60,000	75,000	18
Stelcoloy "G"	Steel Co. of Canada Ltd.	0.10	0.60	0.08	0.03	0.35	0.50	.....	0.50	0.55	.....	50,000	70,000	22
Stelcoloy "S"	Steel Co. of Canada Ltd.	0.12	1.10	0.02	0.03	0.20	0.60	.....	0.50	0.75	.....	50,000	70,000	22
Strenlite	Steel Co. of Canada Ltd.	0.27 max	1.10–1.60	0.04 max	0.05 max	0.30 max	0.20 min	.....	.....	.....	.....	50,000	70,000	22

(Continued on Page S-30)

HIGH STRENGTH STEELS (continued)

Name	Producer	Chemical Composition Limits, Per Cent C	Mn	P	S	Si	Cu	Mo	Cr	Ni	Others	Yield Point Min psi	Tensile Strength Min psi	Min % Elongation in 2 in. for Stand. ASTM Spec.
Stressproof	LaSalle Steel Co.	0.40–0.48	1.35–1.65	0.040 max	0.24–0.33	0.15–0.30	0.15–0.25	.....	.....	.....	.....	100,000	125,000	10
"T-1"	United States Steel Corp., Lukens Steel Co.	0.10–0.20	0.60–1.00	0.040 max	0.050 max	0.15–0.35	0.15–0.50	0.45–0.60	0.40–0.80	0 70–1.00	V 0.03-0.10 B 0.002-0.006	100,000	115,000	18 (4)
"T-1" Type A	United States Steel Corp., Lukens Steel Co.	0.12–0.21	0.70–1.00	0.04 max	0.05 max	0.15–0.35	.....	0.15–0.25	0.40–0.65	.....	V 0 03-0.08 Ti 0.01-0.03 B 0.0005-0.005	100,000†	115,000	18 (4)
Tri-Steel	Inland Steel Co.	0.22 max	1.25 max	0.04 max	0.05 max	0.30 max	0.20 min	.....	.....	.....	V 0.02 min	50.000	70,000	22
Tri-Ten	United States Steel Corp.	0.22 max	1.25 max	0.40 max	0.05 max	0.30 max	0.20 min	.....	.....	.....	V 0.02 min	50,000	70,000	22
U. S. S. Cu-Ni-Mo	United States Steel Corp.	0.21 max	0.80–1.10	0.04 max	0.05 max	0.15–0.30	0.50–0.80	0.20–0.30	.....	1.20–1.50	.....	65,000	140.000	18 (4)
XAR-Abrasion Resistant (5)	Great Lakes Steel Corp.	0.10–0.30	0.60–1.00	0.040 max	0.040 max	0.50–0.90	.....	0.15–0.25	0.45–0.85	.....	Zr 0.03–0.15	165,000	180,000	16 (4)
Yoloy	Youngstown Sheet & Tube	0.15 max	0.75 max	0.10 max	0.05 max	0.30 max	0.75–1.25	.....	.....	1.50–1.85	.....	50,000	70,000	22 (1)
Yoloy 45W	Youngstown Sheet & Tube	0.10–0.20	0.30–1.00	0.05 max	0.05 max	.....	.....	.....	.....	.....	Cb 0.01 min	45,000	60,000	..
Yoloy 50W	Youngstown Sheet & Tube	0.10–0.20	0.30–1.00	0.05 max	0.05 max	.....	.....	.....	.....	.....	Cb 0.01 min	50,000	65,000	..
Yoloy 55W	Youngstown Sheet & Tube	0.10–0.20	0.30–1.00	0.40 max	0.50 max	.....	.....	.....	.....	.. ..	Cb 0.01 min	55,000	70,000	..
Yoloy 60W	Youngstown Sheet & Tube	0.10–0.20	0.30–1.00	0.40 max	0.50 max	.....	.....	.....	.....	.....	Cb 0.01 min	60,000	75,000	..
Yoloy A441	Youngstown Sheet & Tube	0.22 max	1.25 max	0.05 max	0.05 max	0.30 max	0.20 min	.....	.....	.....	V 0.02 min	50,000	70,000	22
Yoloy B	Youngstown Sheet & Tube	0.12 max	0.75 max	0.04 max	0.05 max	0.10 max	.....	.....	.....	.....	V 0.01–0.07	45,000 typ.	62,000 typ.	28 typ.
Yoloy E HS	Youngstown Sheet & Tube	0.18 max	1.00 max	0.10 max	0.05 max	0.30 max	0.20–0.50	0.40 max	0.20–0.60	0.40–1.00	.....	50,000	70,000	22
Yoloy E HSX	Youngstown Sheet & Tube	0.18 max	1.00 max	0.09 max	0.05 max	0.30 max	0.20–0.50	.....	0.20–0.60	0.40–1.00	.....	45,000	80.000 max	25 typ.
Yoloy M Grade A	Youngstown Sheet & Tube	0.25 max	1.60 max	0.05 max	0.05 max	0.30 max	0.20 min	.....	.....	.....	.....	50,000	70,000	20
Yoloy M Grade B	Youngstown Sheet & Tube	0.23 max	1.40 max	0.05 max	0.05 max	0.15–0.30	0.20 min	.....	.....	.. ..	.....	45,000	70,000	22
Yoloy S	Youngstown Sheet & Tube	0.12 max	0.60 max	0.04 max	0.05 max	0.30 max	0.75–1.25	.....	.....	1.65–2.00	.....	65.000	95,000	20 (1, 4)

(1) Steels with copper over a minimum of 0.60 will respond to precipitation hardening, resulting in a higher strength level, depending on time-temperature cycle performed.
(2) Domestic Producers: United States Steel Corp., Acme Steel Co., Algoma Steel Corp., Crucible Steel Co. of America, Greer Steel Co., Inland Steel Co., Lukens Steel Co., Republic Steel Corp. and Sharon Steel Corp.; for Cor-Ten only, Jones & Laughlin Steel Corp.
(3) All licensees for N-A-X High Tensile are also licensed to produce N-A-X Finegrain.
(4) Heat treatment required to meet tensile properties shown.
(5) XAR Abrasion Resistant Steel is normally supplied to a Brinell hardness range of 363 to 400.
(6) Produced to physical properties to meet forming problems of specific parts.
(7) 4100 series..carbon minimum 0.40%. Elevated Temperature Drawn (e.t.d.)
*Compositions are typical, can be adjusted for different properties.
**In 8 in. gage length. †Yield Strength.

PROPERTIES AND TYPICAL APPLICATIONS: Strength of the high strength, low alloy steels as measured by their yield point is about 50 per cent higher than structural carbon steel. Yield points of the alloy and high strength grades are even higher. Working stress in tension can be more than 50 per cent greater. Besides higher yield strengths, they have good corrosion, abrasion, and fatigue resistance and can be fabricated by usual methods. Some applications: Tanks, trailers, trucks, material handling equipment, auto frames, wheels and bumpers, railroad cars, pole line hardware, earth moving equipment, mine cars, agricultural equipment, bridges, buckets, LPG cylinders, screens, towers, booms, cranes, dipper sticks, locomotive parts, mobile lifting equipment, portable military bridges, canal locks, gates and dams, lampposts, auto jacks, cable reels, stokers, furnace bodies, cabinets, re-usable shipping containers, highway sign bridges, line pipe, and building columns.

SUPERSTRENGTH STEELS

Material	Nominal Composition %	Tensile Strength—psi
SAE 4130	C 0.30; Mn 0.50; Si 1.30; Cr 0.95; Mo 0.20	200,000 to 240,000
SAE 4330 modified with Vanadium (AMS 6427)	C 0 30; Mn 0.90; Si 0.30; Ni 1.80; Cr 0.85; Mo 0.45; V 0.05-0.10	220,000 to 240,000
AMS 6428	C 0.35; Mn 0.70; Si 0.30; Ni 1.80; Cr 0.80; Mo 0.35	220,000 to 240,000
SAE 4335 V (AMS 6434)	C 0.35; Mn 0.70; Si 0.30; Cr 0.85; Ni 1.85; Mo 0.35; V 0.20	210,000 to 260,000
SAE 4340 (AMS 6415)	C 0.40; Mn 0.65; Si 0.30; Cr 0.80; Ni 1.80; Mo 0.25	260,000 to 280,000
A-9 Firedie N Smoothcut (Columbia)	C 0.51; Mn 0.45; Si 1.10; Cr 5.00; Mo 1.35; V 1.05; Ni 1.50 (with free machining additives); Fe bal	220,000 to 300,000
Timken 4741	C 0.40; Mn 0.75; Si 0.50; Cr 0.95; Ni 0.85; Mo 0.35	300,000 max
300-M Ultrahigh Strength Steel	C 0.40; Mn 0.70; Si 1.60; Ni 1.90; Cr 0.90; Mo 0.45 V 0.07	280,000 to 300,000
U. S. Steel Air Steel X-200	C 0.43; Mn 0.85; Si 1.50; Cr 2.00; Mo 0.50; V 0.05	280,000 min
USS Strux (Mod. 98BV40)	C 0.35-0.40; Mn 0.85; Si 0.70; Ni 0.80; Cr 0.75; Mo 0.50; V 0.06; B 0.0015	260,000 to 280,000
USS Strux (Mod. 98BV40) AMS 6423	C 0.40-0.45 version of above	280,000 to 300,000
5CrMoV Aircraft Steel (1) (Modified H-11); AMS 6437;	C 0.40; Si 0.9.., Cr 5.00; Mo 1.30; V 0.50	220,000 to 300,000

SAE 4360	C 0.60 version of 4340	280,000 to 300,000
SAE 8620	C 0.20; Mn 0.80; Si 0.30; Cr 0.50; Ni 0.55; Mo 0.20	Carburized for increased strength.
SAE 8740	C 0.40; Mn 0.90; Si 0.30; Cr 0.50; Ni 0.55; Mo 0.25	210,000 to 260,000
SAE 9310	C 0.10; Mn 0.55; Si 0.30; Cr 1.25; Ni 3.25; Mo 0.12	Carburized for increased strength.
Crucible HY-Tuf (AMS 6418)	C 0.25; Mn 1.30; Si 1.50; Ni 1.80; Mo 0.40	230,000
Crucible UHS-260	C 0.35; Mn 1.25; Si 1.85; Cr 1.25; V 0.20; Mo 0.35	260,000 min
D6C, D6AC	C 0.46; Mn 0.75; Si 0.25; Cr 1.05; Ni 0.55; Mo 1.00	220,000 to 280,000
Firth Sterling Astro-1	C 0.37; Cr 5.25; Mo 1.30; Si 1.00; V 0.50	220,000 to 290,000
Timken H.S. 220 (AMS 6407)	C 0.30; Mn 0.70; Si 0.60; Ni 2.05; Cr 1.20; Mo 0.45	220,000 to 240,000
Timken H.S. 260	C 0.40; Mn 0.70; Si 0.60; Cr 1.20; Ni 2.05; Mo 0.45	260,000 to 280,000
VascoJet 1000; Crucible 218; Potomac A; Dynaflex; Unimach I; Chromo V		
Unimach II	C 0.50; Mn 0.40; Si 1.00; Cr 5.00; Ni 1.50; Mo 1.40; V 1.00	220,000 to 310,000
Unimach UCX2	C 0.39; Mn 0.70; Si 1.0; Cr 1.10; Mo 0.25; V 0.15; Co 1.0	310,000

APPLICATIONS: In their appropriate tensile strength ranges, these steels are designed to provide the maximum usable strength where minimum weight is of primary importance. Such uses are in aircraft landing gear and air frame components, wing pylon parts and fasteners, wing attachment fittings, and superstrength bolts. Other applications: Sheet or plate parts for supersonic speeds, pressure vessels for aircraft use, oil well perforating guns and carbide bit bodies. Examples of other constructional parts are axles, gears, and shafting of all types. Although the acceptance of many of these superstrength steels will be a gradual process, today's trend toward machines and equipment operating at higher and higher stress levels will increase their ultimate use in many ways.
(1) Other tool steels, such as the S-1 and S-5 types, have high strengths, in the 300,000 psi range. Physical property data can be obtained from the producers.

TITANIUM

Material (nominal composition)	Specifications: AMS	Specifications: Military	Specifications: ASTM	Producers' Designations	Mill Forms	Tensile Strength (psi)	Yield Strength (psi)	Elong. (%)	R.A. (%)	Properties and Applications
Unalloyed				Ti-35A	S,B,E,W,T	35,000	25,000	25	35	Special soft grade for uses where structural strength is less important than corrosion resistance. Heat exchangers.
Unalloyed		MIL-T-12117 class 40	B-265-58T B-338-59T B-338-58T B-337-58T	RM-30 Ti-45A	S,B,E,W,T	45,000	35,000	22	35	Valves, heat exchangers, dished heads, and similar uses where corrosion resistance is an important design consideration.
Unalloyed	4902 4941 4951	MIL-T-9046C MIL-T-12117 class 50	B-265-58T B-338-59T B-338-58T B-337-58T	RM-40 RS-40 A-40 Ti-55A	S,B,E,W,T	65,000	50,000	28	50	Nonstructural aircraft and corrosion uses where ductility and formability are needed. Fusion weldable. Processing equipment, fittings, heat exchangers, valve trim, marine uses.
Unalloyed	4900A	MIL-T-9046C MIL-T-7993 class II	B-265-58T B-338-59T B-338-58T B-337-58T	RM-55 RS-55 A-55 Ti-65A	S,B,E,W,T	80,000	65,000	25	50	Properties and uses same as above except it has higher strength. Used as rods and wire for welding other titanium alloys; anodizing racks.
Unalloyed	4901B 4921A	MIL-T-9046C MIL-T-12117 class 70 MIL-T-7993 class I	B-265-58T B-338-58T B-337-58T	RM-70 RS-70 A-70 Ti-75A	S,B,E,W,T	90,000	80,000	20	40	As above, but higher strength with some sacrifice in ductility and formability. Aircraft nacelles, webs, stiffeners, angles, shrouds, fire walls, fasteners, engine rings, ammunition boxes, gun blast panels, shroud spacers, anodizing racks.
Unalloyed	4921A	MIL-T-9047C MIL-T-9011	B-265-58T	Ti-100A	B	80,000	70,000	15	30	Properties and uses same as above.
ALPHA TITANIUM ALLOYS										
0.15 Pd				Ti-Pd	S,B	65,000	50,000	28	50	Chemical process equipment to withstand oxidizing and reducing environments.
5Al-2.5Sn	4910 4926 4953	MIL-T-9046C MIL-T-9047C	B-265-58T B-338-59T	RM-5Al-2.5Sn RS-110C A-110AT Ti-5Al-2.5Sn	S,B,W,F	125,000	115,000	18	40	Forgings and welded sheet for creep resistance up to 900° F. Aircraft engine compressor case housings, tail cones, shroud spacers, stiffeners, high strength fusion welded assemblies, cryogenics tankage.
8Al-1Mo-1V				Ti-8Al-1Mo-1V	S,B	147,000	135,000	16		High temperature jet engine forging alloy. Useful for airframes where creep properties of other alloys are not good enough at elevated temperatures. Extends temperature range about 150° F over alloys like 6Al-4V.

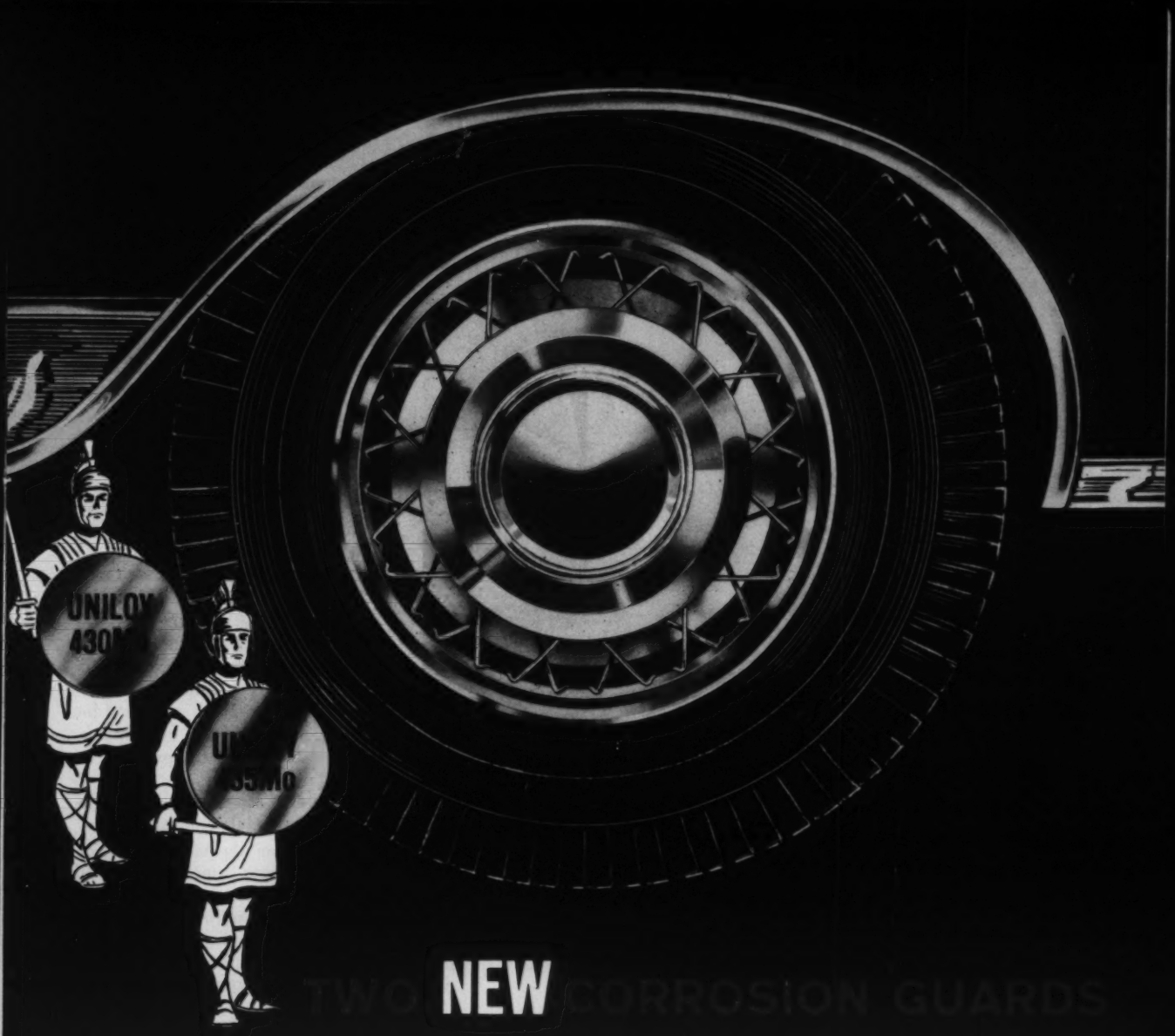
(Continued on Page S-32)

TITANIUM (continued)

Material (nominal composition)	Specifications: AMS	Specifications: Military	Specifications: ASTM	Producers' Designations	Mill Forms	Tensile Strength (psi)	Yield Strength (psi)	Elong. (%)	R.A. (%)	Properties and Applications
Alpha Titanium Alloys (continued)										
8Al-2Cb-1Ta				RM-821	S,B,E,W,F	135,000	125,000	15	40	Compressor blades, fire walls, tail cones, stiffeners, welded assemblies. High strength forgings. Has exceptional high temperature strength —about 200° F advantage in the 400 to 1000° F range, over 6Al 4V.
ALPHA-BETA TITANIUM ALLOYS										
3Al-2.5V				RM-3Al-2.5V	S,E,T	100,000	85,000	15		Highly weldable; particularly suitable for fabricating into welded and seamless tubing.
3Al-5Cr	4927	MIL-T-9047C		RM-3Al-5Cr	B,F	145,000	135,000	13	35	Aircraft forgings; fasteners.
2Fe-2Cr-2Mo	4923	MIL-T-9047C MIL-T-9046C		Ti-140A	S,B,F	130,000	115,000	15	25	Airframes, skins.
8Mn	4908A	MIL-T-9046C	B-265-58T	RM-8Mn RS-110A C-110M Ti-8Mn	S	130,000	120,000	15		For medium, high strength, sheet uses where good formability is needed. Not used for fusion welded assemblies or above 650° F. Longerons, bulkheads, channels, stressed skins, and frames.
4Al-4Mn	4925A	MIL-T-9047C		RM-4Al-4Mn RS-130 C-130AM	B,W,F	145,000	133,000	15	40	High strength airframe and engine forgings and fasteners where good weld ductility is not needed. Industrial equipment requiring maximum strength with good corrosion and erosion resistance.
4Al-3Mo-1V*	4912 4913			RM-431 RS-115 C-115AMoV Ti-4Al-3Mo-1V	S	133,000	123,000	11		Heat treatable sheets with good formability in solution condition. To get 155,000 psi yield strength, heat treat at 1650° F, water quench, and age at 925° F for 12 hours.
5Al-2.75Cr-1.25Fe*				RS-140 Ti-5Al-4FeCr	B,S	158,000	147,000	16	40	High strength forgings and sheet parts. Heat treatment increases tensile strength to 180,000 psi with corresponding increase in yield strength.
5Al-1.5Fe-1.4Cr 1.2Mo*	4929 4969	MIL-T-9047B		Ti-155A	B	145,000	135,000	10	20	Heat treatable forging stock for aircraft parts. Heat treatment gives average yield strength of 173,000, tensile strength of 180,000 psi. Heat treat capability guaranteed to 170,000 psi.
6Al-4V*	4928 4911 4935	MIL-T-9046C MIL-T-9047C	B-338-59T	RM-6Al-4V RS-120A C-120AV Ti-6Al-4V	S,B,E,W,F	145,000†	130,000	13	40	Medium high strength aircraft and engine forgings. Ordnance equipment elevated temperature strength and stability with good machinability. Compressor wheels and blades, spacers, cryogenics, rocket cases.
7Al-4Mo*				RM-7Al-4Mo RS-135 C-135AMo Ti-7Al-4Mo	B,E,T	145,000	135,000	10	20	Heat treatable forging alloy combines good creep resistance, stress stability, and high temperature strength. Used in aircraft turbines for compressor wheels and blades, hub-shafts, spacer rings, airframes.
2.5Al-16V*				RM-2.5Al-16V	B,S,W	175,000**	160,000	6		Airframe skins, webs, angles, shrouds, and fasteners. Age hardened parts have good short time hot strength (yield strength about 100,000 psi up to 800° F). Sheets are heat treatable with good formability in solution treated condition.
BETA TITANIUM ALLOYS										
13V-11Cr-3Al*				RS-120B B-120VCA Ti-13V-11Cr-3Al RM-13V-11Cr-3Al	S,B,W	125,000	120,000	10		Weldable, heat treatable alloy for solid propellent pressure casings. Cold rolled and aged sheet provides tensile strengths in excess of 210,000 psi.

*Indicates response to heat treatment. (Guaranteed heat treat capabilities of alloys responding to heat treatment available from producers.)
**Age hardened. ***Vacuum annealed. †Sheets from Reactive Metals Inc., 180,000.
S—Sheets, strip, plates. E—Extrusions. T—Tubes.
B—Bars and billets. F—Forgings. W—Wire.

Producers' designations:
RM—Reactive Metals Inc., Niles, Ohio.
RS—Republic Steel Corp., Massillon, Ohio.
A, B, and C— Crucible Steel Co. of America, Midland, Pa.
Ti—Titanium Metals Corp. of America, New York.



UNILOY 430Mo and UNILOY 435Mo STAINLESS STEELS

1962 models of major automobile manufacturers will take to the road with exterior parts produced from two new molybdenum bearing straight chromium stainless steels developed by Universal-Cyclops for maximum corrosion resistance.

UNILOY 430Mo—designed for use where *roping is not a factor.*

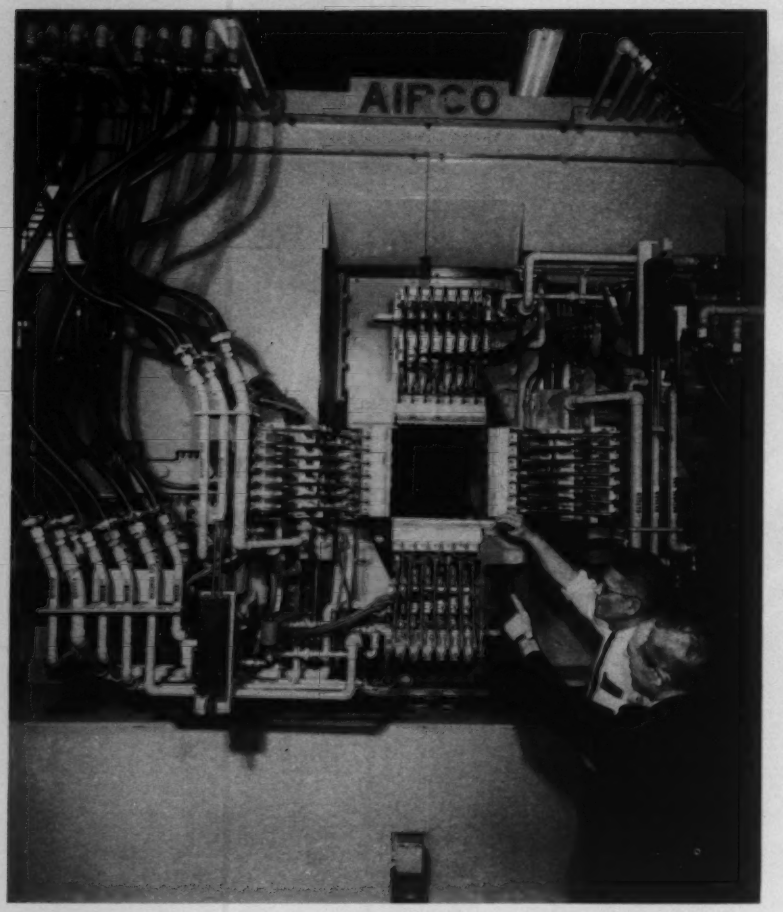
UNILOY 435Mo—designed for use where *roping is a factor.*

Exhaustive testing by Universal-Cyclops during the development of these alloys—confirmed by laboratory and production testing by automobile manufacturers—has proven that these two new stainless steels not only provide extremely high corrosion resistance, but also, outstanding fabricating and finishing qualities.

These new stainless steels are available with Universal-Cyclops' UNIBRITE finish—buffed beauty both sides. And, in production quantities in a full range of strip sizes. Uniloy 430Mo is also available in wire.

UNIVERSAL CYCLOPS
UC STEEL
STEEL CORPORATION
EXECUTIVE OFFICES: BRIDGEVILLE, PA.

STAINLESS STEELS • TOOL STEELS • HIGH TEMPERATURE AND REFRACTORY METALS



Hoods are removed from the machine for inspection of scarfing heads before delivery. The heads are adjustable to accommodate a wide range of bloom sizes

Automatic Flame Scarfer Gives Blooms Flat Finish

Multiple orifice heads spray oxygen on the steel to remove surface defects. Metal removal depth is determined by preset bloom speed and oxygen flow rate

• SEMIFINISHED steel will be given a clean, flat surface by an automatic, hot flame scarfing machine as it comes off the blooming mill at the Vernon (Calif.) plant of Bethlehem Steel Co.

The machine, installed recently by the Special Products Dept., Union, N. J., of Air Reduction Sales Co., is one of seven such units being built by Airco for steel industry applications. It will handle blooms of high and low carbon steels at speeds of 50 to 150 ft a minute.

• The machine can be used to put a smooth, clean surface on several sizes of billets and blooms.

The electronically controlled unit is designed to produce clean, flat scarfed surfaces on semifinished shapes. Removal of cracks, seams, blisters, and other surface defects helps insure high quality products from subsequent rolling.. Some of the steel produced at the plant is marketed as billets, bars, or rods. Some is drawn into wire, and some is made into bolts, nuts, and rivets.

The scarfer will be applied to a wide range of bloom sizes (4 by 4 in. to 14 by 14 in.) at Vernon. It will probably be used chiefly on 5 by 7 in. sections. One operator controls the scarfer from the pulpit as it removes inperfections from the surface of semifinished shapes at rolling mill temperatures.

The machine at the Vernon plant—like those still under construction—is tailored for the mill. Each scarfer is a complicated system of scarfing arms, supports for scarfing heads, control instruments, and gas dispensing equipment.

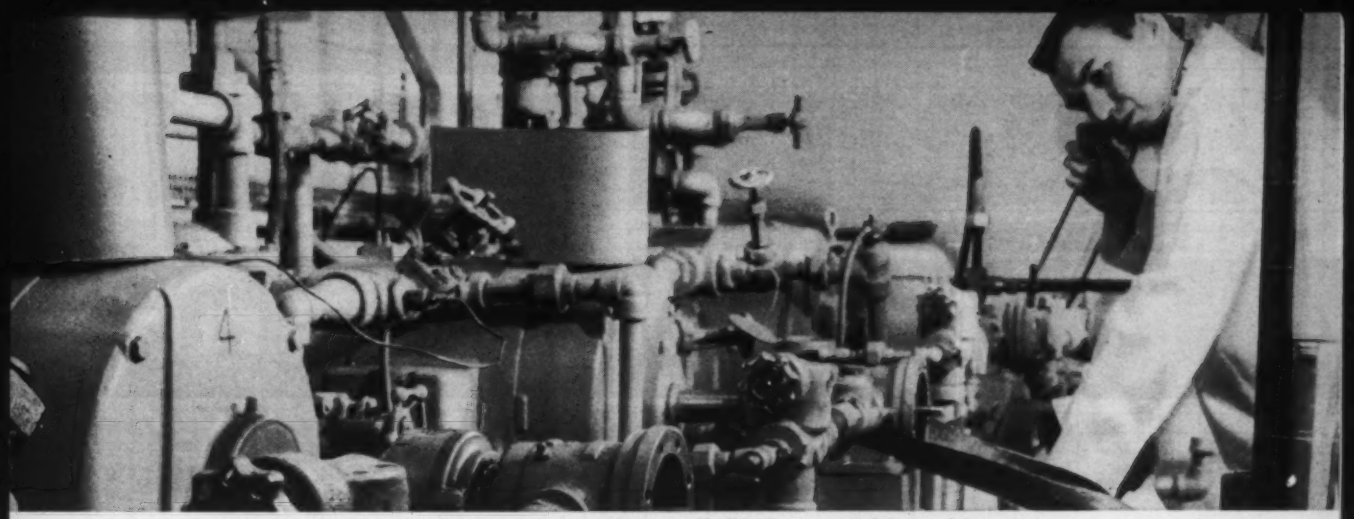
• Automatic scarfing cycles make for uniform metal removal.

Blooms from the mill are carried to the scarfing machine on roll tables, which the operator starts and stops with a selector switch in the control pulpit. The leading end of the bloom is positioned at the front of the unit by remote control and preheated by oxygen-natural gas burners.

When the steel is heated to about 1800° F, the operator initiates oxygen flow and sends the bloom through the scarfer.

Preset travel speeds and oxygen flow determine the depth of metal removal from the unfinished steel shapes. During the scarfing cycle, water sprays inside the scarfing hood flush away accumulated slag. The scarfing of 1000 tons of steel produces about 210 cu ft of slag.

Scarfing continues until the trailing end of the bloom approaches the preheat burners. At the end of the cycle, the operator actuates a selector switch that automatically stops the flow of scarfing oxygen, preheat gases, and cooling water. Another switch in the scarfing machine pulpit is actuated to transfer control of blooms back to the mill operators.



Listening for pump chatter. Here—in Shell's Martinez, California, laboratory Shell Tellus hydraulic oils are subjected to the most demanding tests.

BULLETIN:

Shell presents a question-answer guide to help you select the hydraulic oils for top performance

Selecting the proper hydraulic fluid for your equipment can be one of your most important decisions. And it can pay off in many ways. Less down-time. Longer equipment life. Lower cost per unit.

Here are six bench marks to help you pick the best hydraulic oil for your plant requirements.

1. Does it have good oxidation stability? Oxidized hydraulic oil can form gums, lacquers and other deposits which may foul moving parts. Shell Tellus Oils are carefully refined to remove unstable, sludge-forming components—then fortified with a Shell-developed oxidation inhibitor.

2. Will it resist foaming and emulsification? Pump chatter and erratic operation are often the result of pump cavitation, brought on by oil foaming. Tellus® Oils contain additives to help prevent foaming.

3. Does it fight rust and corrosion? It is difficult to exclude all moisture from a hydraulic system. And moisture can form troublesome rust. Shell Tellus Oils have been carefully compounded to resist corrosion.

4. What are its lubrication qualities in continuous service? Shell Tellus Oils form a clinging, oily film on mating metal surfaces. This maintains a constant guard against wear.

5. How does it react to temperature changes? This is a key factor in the performance of hydraulic equipment. Careful selection of the proper viscosity grade of Tellus assures satisfactory operation of your system over its entire temperature range.

6. Is it available in several viscosity grades? Shell Tellus Oils are available in a broad range of viscosity grades. There's a special grade for virtually every hydraulic requirement.

Ask your Shell Industrial Products Representative for facts on Tellus Oils. Or write: Shell Oil Company, 50 West 50th St., New York 20, N. Y.

A message to manufacturers of hydraulic equipment

There is a Shell Tellus Oil suited for your equipment.

1. Your customers can get Tellus Oils at Shell depots everywhere. Readily available throughout the world.

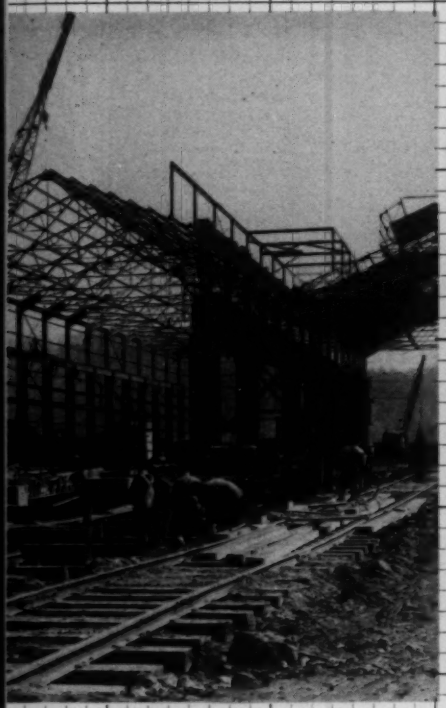
2. Quality is consistently high. Tellus always delivers top performance.

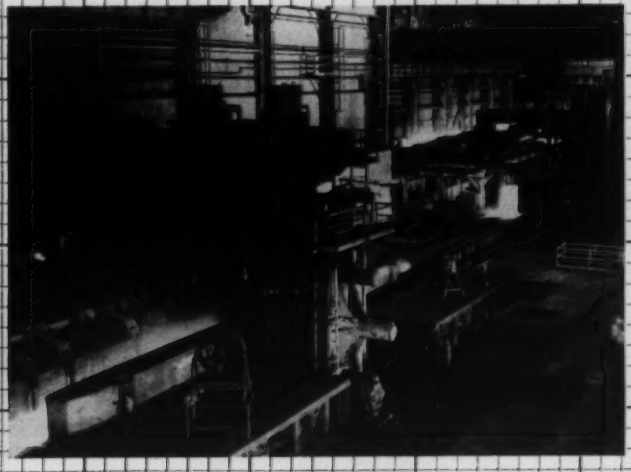
SHELL

A BULLETIN FROM SHELL
—where 1,997 scientists are working to provide better products for industry

SWINDELL

Plant Engineering





-DRESSLER

and Manufacturing

for the STEEL INDUSTRY

SWINDELL-DRESSLER engineering covers the range of steelmaking requirements from feasibility studies to complete plants and owners' key. Integrated steel mills, basic oxygen steel plants, electric steel melt shops, gas cleaning systems, departmental expansion or remodernization are among the many areas served by this long-experienced metals engineering organization.

- In manufacture, SWINDELL applies a background of 112 years to the most modern melting, annealing and heat processing of steel. Electric arc, open hearth, car bottom, annealing and malleableizing furnaces; soaking pits; billet heating, roller hearth and elevating furnaces with the Swindell nameplate serve the industry well.
- You can depend upon Swindell-Dressler engineering and Swindell products for your most exacting production demands. Let's discuss your program, at an early date.

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CORPORATION

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The SWINDELL-DRESSLER CORPORATION of Canada, Ltd., Toronto, Canada

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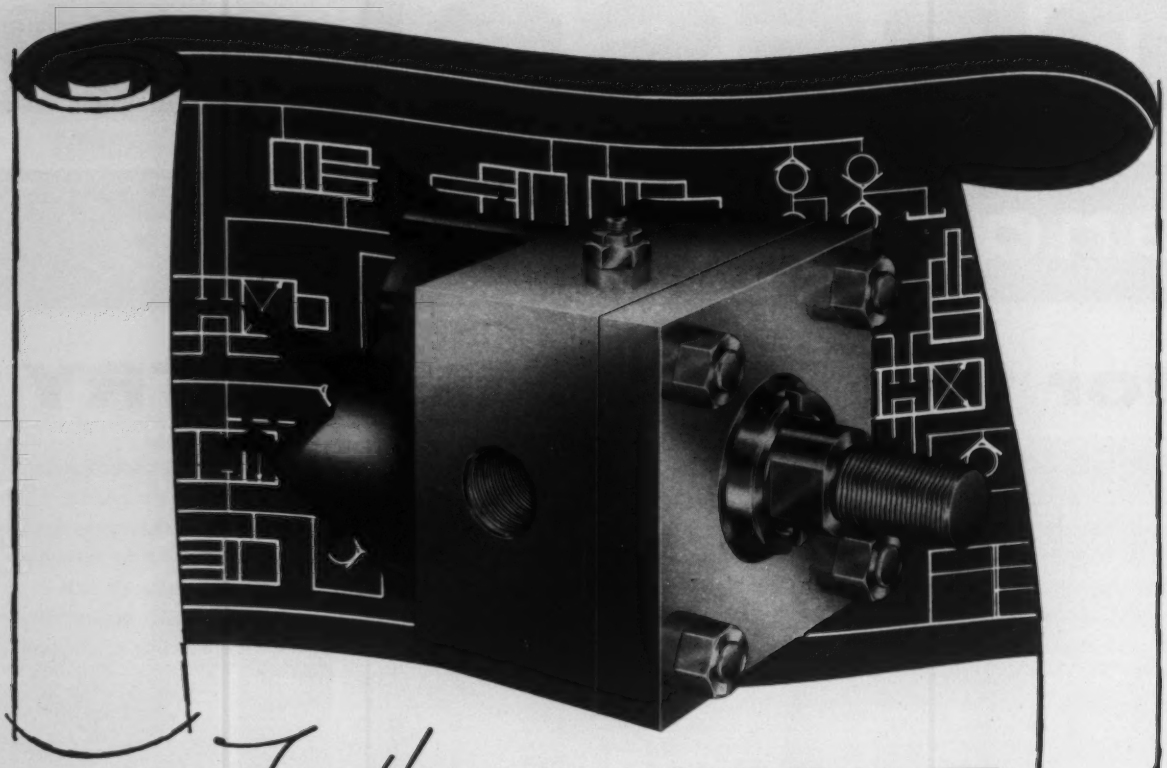

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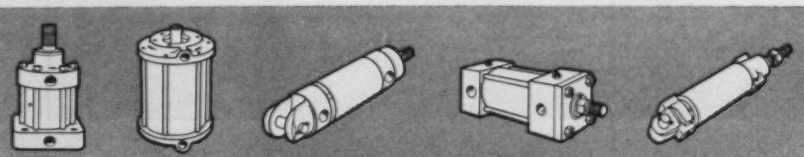
From its blueprint stage to its maintenance engineering requirement sheet, your product will assure MORE power drive precision and service, if T-J cylinders are specified. T-J's complete line too, from the Spacemaker to the new replaceable Squair Head, can be the answer to any power problem. Write or call The Tomkins-Johnson Company, 2425 W. Michigan Ave., Jackson, Michigan, today!

T-J OFFERS THE ONLY COMPLETE CYLINDER LINE



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RIVITORS...AIR AND HYDRAULIC CYLINDERS...CUTTERS...CLINCHORS

Representation in all major areas, including Canada.

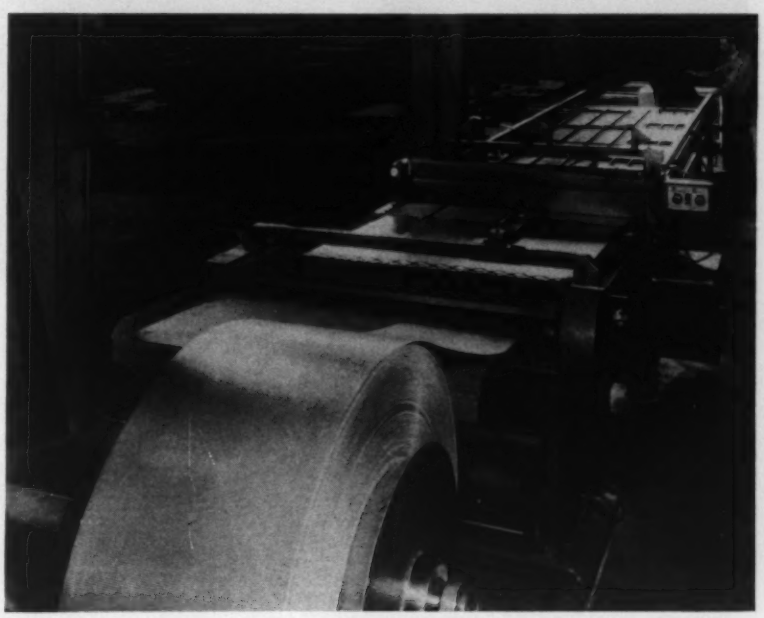
Leveler, Cut-to-Length Line Handles 60 in. Coils

A ROLLER leveler and cut-to-length line is designed for warehouses handling steel and aluminum, or for manufacturers that buy sheets in volume.

The line is available in two models: Model 204844 accommodates 48 in. rolls (width) and Model 206044 handles 60 in. rolls. The line can handle sheets 12 to 240 in. long. Capacity: Steel 0.035 in. thick (20 gage) and ½ hard aluminum 0.050 in. thick.

The line can handle coils up to 7500 lb with a maximum outside diameter of 48 in. and a 16 in. minimum, 24 in. maximum, inside diameter. The leveler travels at 40 ft per minute. Shearing is done at 300 strokes per minute

For further information, *write* Huron Inc., 8348 Vine St., Cincinnati 16 Ohio.

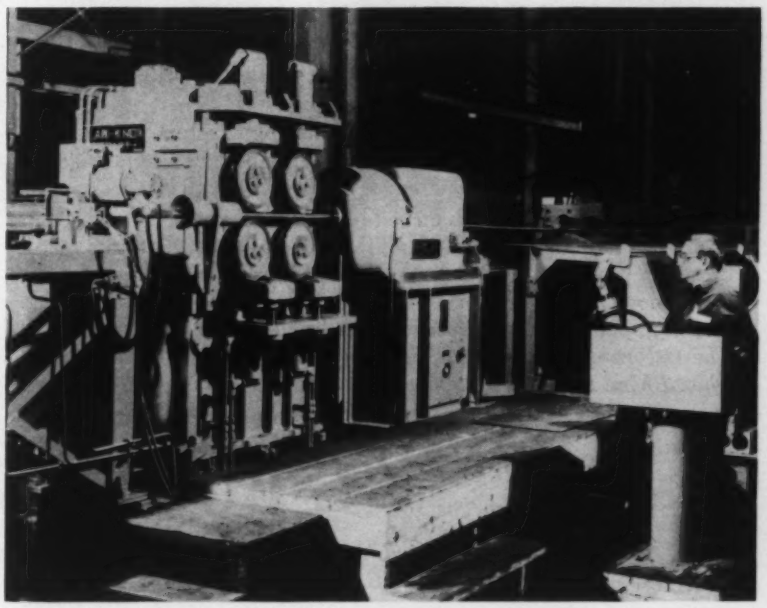


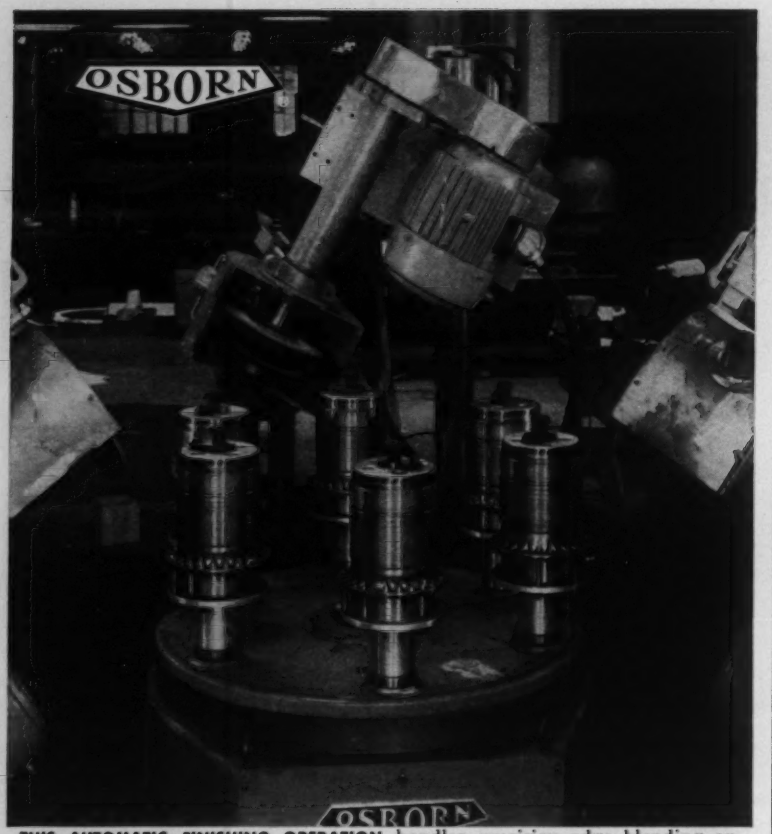
Centerless Turning Done with Carbides, Ceramics

THIS high speed, centerless bar and tube turning machine is designed for carbide and ceramic tooling. It'll turn workpieces at feed rates up to 30 fpm (60 fpm on the smaller sizes). The first of the units has been placed in operation in the Baltimore Works of Armco Steel Corp.

A single cutterhead, designed for mechanically clamped tools, makes it possible to change cutting edges eight times without resetting them. All rubbing or friction guides in the cutterhead are eliminated. The torque chipper is supplemented by a pressure support collet to give absolute rigidity at the point of turning. Additional rigidity to the workpiece is obtained through a series of pressure loaded steadying rolls on the input and output feed devices.

Tables are automatic. A load of bars can be run end to end, non-





THIS AUTOMATIC FINISHING OPERATION handles precision edge blending on aircraft engine cylinder barrels. Setup consists of an Osborn 6-station index table and three finishing heads equipped with Osborn Fascut® Brushes with deburring compound. Heads No. 1 and 3 each brush one minute clockwise and ccw to put .020" blend on edges of mounting holes. Head No. 2 brushes 1½ minutes cw and ccw to put .010" blend on top edge and O.D. thread ends.

EDGE BLENDING cylinders

done 566% faster with OSBORN power brushing

Here's an aircraft manufacturer with a problem: specifications for these reciprocating engine cylinder barrels called for precision tolerances. Hand finishing rate: 3 parts an hour . . . too slow . . . too costly.

Today, an automatic Osborn Metal Finishing Machine handles the work . . . *power brushing* the parts rapidly, uniformly, economically. Rate: 20 an hour . . . *566% faster with exceptional quality control.*

It's another case-in-point of today's Osborn power brushes and brushing methods at work throughout industry solving tough metal finishing problems. An **O**sborn **B**rushing **A**nalysis—made in your plant now at no obligation—can cut costs on *your* deburring, cleaning, polishing and precision blending operations. Write or call *The Osborn Manufacturing Company, Dept. S-40, Cleveland 14, Ohio. Phone ENdicott 1-1900.*

OSBORN

Metal Finishing Machines . . . and Finishing Methods

Power, Paint and Maintenance Brushes • Foundry Production Machinery

NEW PRODUCTS and equipment

stop, without any assistance from the operator.

Separate, variable speed motors drive the feeding elements and the cutting tools so that any desired combination of tool tip and throughput feed may be obtained. The company says the support method of holding the bar on each side of the series of cutting tools produces a smoothly turned bar surface at high throughput rates.

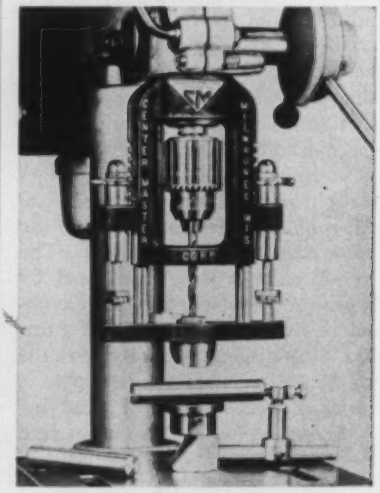
The manufacturer has several sizes to handle diameters of ⅜ to 6 in. Larger sizes can be obtained. By using auxiliary coil handling equipment, wire from a coil can be shaved or turned.

For further information, *write* Blaw-Knox Co., 300 Sixth Ave., Pittsburgh 22, Pa.

Drill Press Attachment Easy to Set Up, Run

EASY setup and operation are advantages of the drill press attachment called Center Master. The attachment (for quills of ½ in. drill presses) can hold, locate, and guide the cutting tool on any round, hexagonal, or square part. In many cases, drill jigs or special holding fixtures can be eliminated, says the manufacturer.

In addition to fast, controlled production on standard drilling operations, the Center Master can be set up for burr or nib cutoff, off-



(*Please turn to Page* 161)

(Advertisement)

HERE'S WHY...

POTOMAC® M IS THE FASTEST GROWING DIE STEEL IN THE DIE CASTING INDUSTRY

- ***Product Quality***—the characteristics and properties you require in a die block . . . the machinability, stability, response to heat treatment . . . the *right* grade for your job.
- ***Facilities***—unmatched, by anyone, anywhere . . . production equipment specifically designed for the job at hand.
- ***Availability***—stock on the shelf, finished and ready for you . . . and job-shop delivery schedules, the industry's most dependable.

3702-1

(Advertisement)

PRODUCT QUALITY through...

Die quality clear to the center . . . upset forging quality . . . and in pressed billet stock! That's what puts Potomac M . . . A-L's H-13 Die Steel . . . in a class by itself. And *that's* the kind of quality that's absolutely mandatory for the intricate interior patterns in today's complex diecasting dies.

Quality like this has been associated with Allegheny Ludlum Die Steels over the past 20 years, during a period when die blocks were generally running less than 1200 pounds. Holding rigid specifications on ultrasonic soundness, grain size, and response to heat treatment in blocks of this size was one thing. Offering consistently higher quality in much larger die blocks . . . more and more the rule these days . . . is something else again.

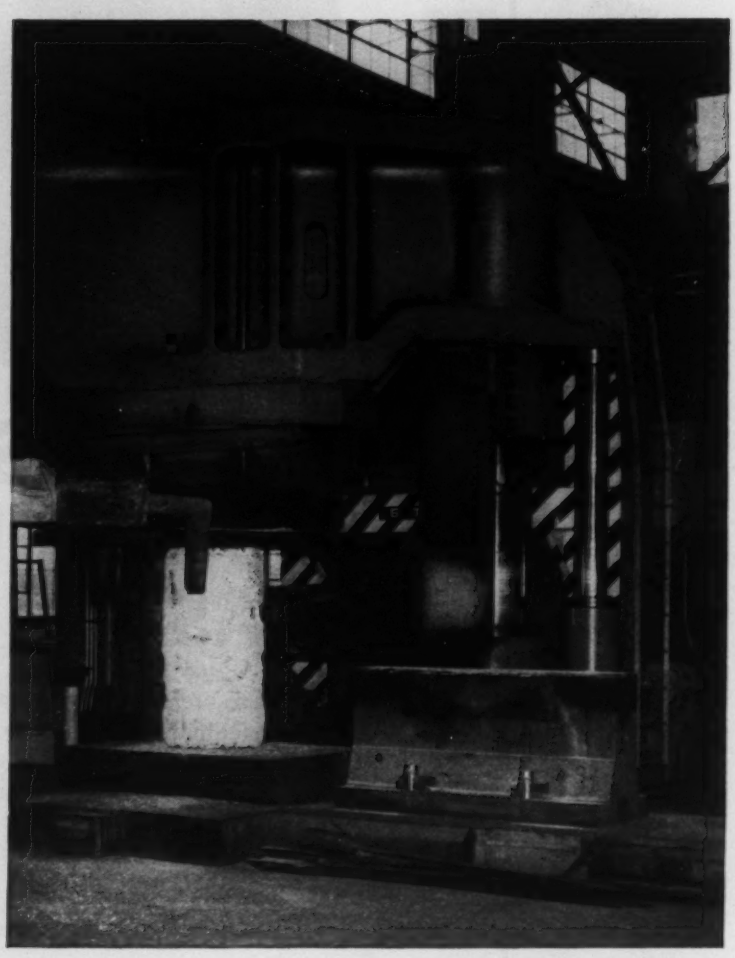
But, Allegheny Ludlum has become *the* specialist in doing just that . . . in providing these massive chunks of steel with the same center quality, machinability, and mechanical properties generally associated with much smaller sections.

And here's what it means to you

It means that Potomac M dies have greater strength in the transverse direction, and combine the ultimate in toughness with machinability and size stability. It means water cooling channels may be employed without the risk of cracking your dies due to thermal shock. It means better resistance to abrasion and softening at elevated temperatures . . . and, greater resistance to wash and heat checking. Most important, it means Potomac M is specifically created, and specifically processed for you . . . the most practical and useful material for your diecasting needs.

. . . A-L's 2,000 Ton Forging Press

Production equipment specially designed for the job at hand is part of the story. The direct pumping facility and fast, closely controlled action of A-L's unique forging equipment permits greater reductions in area from ingot to billet in a single heating, and results in complete ingot reduction in a relatively short time, with fewer reheats necessary. Coupled with A-L's ability to produce ingots up to 40″, of superior quality as-cast, the capacity of this press to rapidly and *completely* work such ingot grain structure inevitably results in an exceptionally high center quality in the billet, together with a refined grain structure more responsive to heat treatment. Substantially improved mechanical properties are obtained in the forged die blocks, with particular improvement in transverse tensile strength and ductility.



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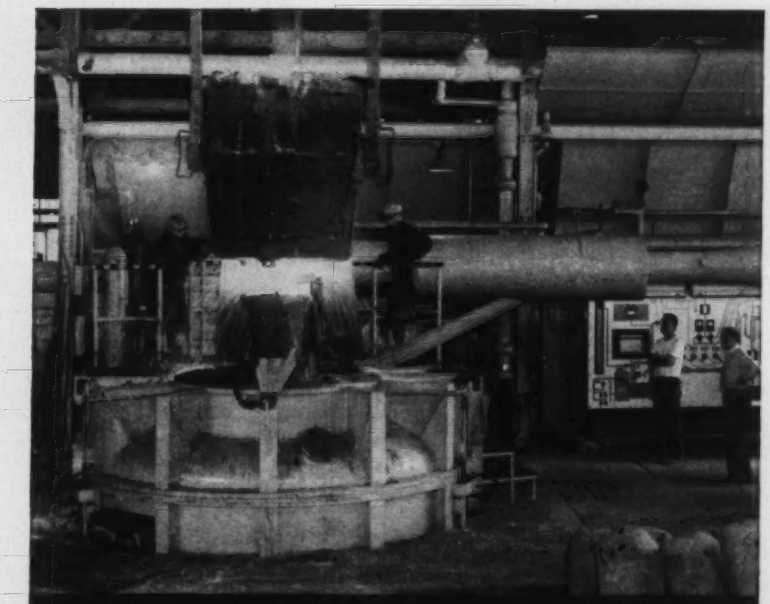
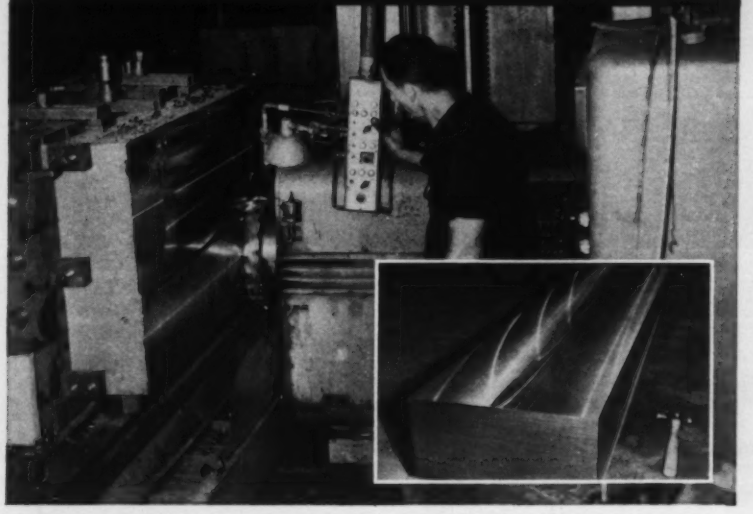




...A-L's Vacuum Degassing

Potomac M Die Steel is vacuum degassed . . . as a matter of routine. Vacuum degassing results in a cleaner steel, without blemishes or subsurface discontinuities . . . those imperfections which often reveal themselves in the die only after considerable machining has been done. Vacuum degassing produces a steel with lower oxygen and hydrogen content, with greatly reduced tendency toward microcrack formation, with fewer nonmetallic inclusions . . . a steel with better, more reliable mechanical properties clear through.

...A-L's Special Melting

For the unusual die applications requiring the ultimate in cleanliness and center quality, Allegheny Ludlum now offers its Consutrode® Potomac M. For requirements involving a super-finish die, the superior cleanliness of this vacuum melted product assures the die maker of an unblemished working surface clear through the workpiece. Equally important, this vacuum melted steel provides an improved transverse ductility in large die blocks, particularly applicable to dies which require the ultimate in toughness and resistance to thermal shock.

...A-L's Machined Finish

All bars and blocks in the larger sizes are milled to a finish that permits die layout right on the steel we ship. Finished closer to final size, there's much less wasted metal to wind up as chips on the floor of your shop. Allegheny Ludlum Potomac M die blocks are delivered to you free from scale and decarburized surface areas, and ready for your diemakers.

3702-3

AVAILABILITY

Allegheny Ludlum's Potomac M is part of the Steelector Program, a unique system which enables tool steel buyers to select the proper steel on the basis of intended application, and check on the availability of the desired size and shape before any purchase decision is made or any paperwork issued. Individual Data Stock Lists for each Steelector Grade clearly set forth the size and shapes of bars and billets available from stock . . . sizes which will serve the requirements of all users. This is all finished stock . . . over 320,000 pounds of Potomac M . . . on the shelf, ready for you. And, it's backed up by over 180,000 pounds of Potomac M billet stock, ready at the mill for finishing to your specifications, should the size, weight or shape of your order take it out of depot stock category. To learn how you can take advantage of this special stocking plan on tool and die steels, contact your local A-L Representative, and ask him about the Steelector Program and the job-shop availability of special sizes, or write Allegheny Ludlum Steel Corporation, Oliver Building, Pittsburgh 22, Pa.

Back-up stocks of ingots and billets insure job-shop delivery schedules on mill shipments. Here, Potomac M billet stocks at the Dunkirk Plant of Allegheny Ludlum await finishing operations.

A corner of an Allegheny Ludlum Warehouse, with part of the finished stocks of large Potomac M die blocks that permit customers to quote on short delivery jobs without expensive inventories.

STEELECTOR PROGRAM

ALLEGHENY LUDLUM

Tool Steel warehouse stocks throughout the country

3702-4

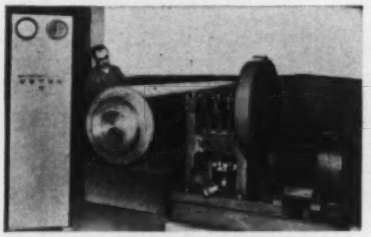
(*Continued from Page* 156)

center drilling, and special drilling with V-bushings.

For further information, *write* Portage Double Quick Inc., 1049 Sweitzer Ave., Akron 11, Ohio.

Isostatic Presses Compact Powdered Metals

ISOSTATIC pressing systems for performing high density, uniform compaction of irregularly shaped powdered metal or ceramic parts are available from Autoclave Engineers. Included in the packaged outfits are pumping equipment, compression cylinder, pressure vessel, valving, and instrumentation.



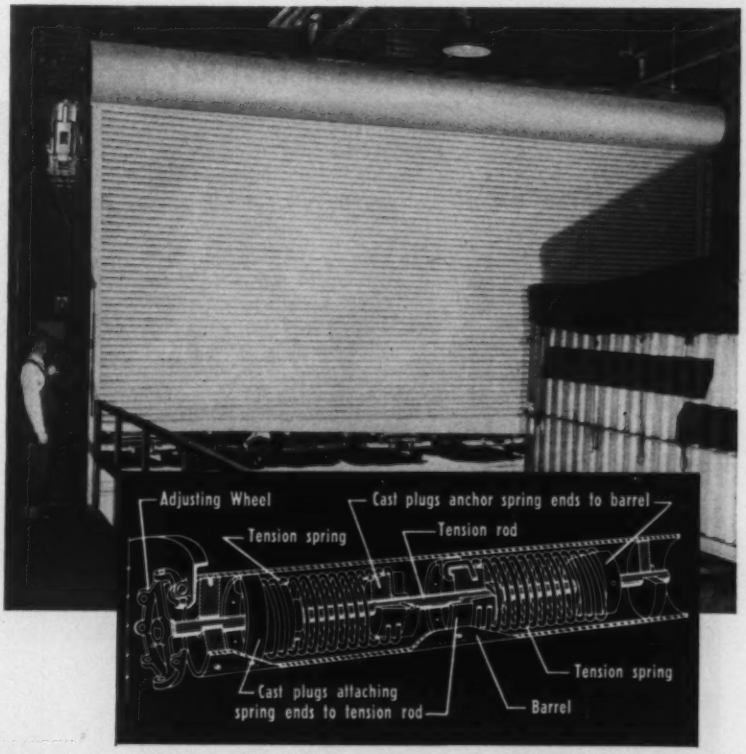
The systems can be designed for manual or automatic operation. A wide range of capacities is available.

For further information, *write* Autoclave Engineers Inc., 2972 W. 22nd St., Erie, Pa.

Variable Displacement Pumps Servocontrolled

A LINE of two way, variable displacement pumps (type DV) comes with electrohydraulic, servo-operated controls. The maker says any number of variable, low level electrical input signals (5 watts or less) can accurately and proportionately vary the rate of pump flow from either directional port. The equipment can be set up to drive and control a wide variety of equipment.

The servocontrol valve varies pump displacement from zero to maximum in 0.15 of a second on small units and in 0.25 of a second on large units. Strokers with smaller cylinders (for higher pilot pressure) to reverse maximum flow



There's a "Barrel of Difference" in Kinnear Rolling Door Quality!

"Longer door life at lower cost" — so often noted by users of Kinnear Rolling Doors — is due to extra strength and quality built into every feature, *including the unique counterbalance system "hidden" beneath the door's hood!*

As illustrated above, special cast plug devices anchor one end of each spring to the barrel, and to the other end to the tension rod, which extends through the door bracket into the adjusting wheel.

No disassembly required to adjust total curtain tension

The adjustment wheel turns all springs an equal amount, in the same direction. The ideal counterbalance action is quickly and easily arrived at, without any disassembling, and tension is always equal on each spring, at all points of curtain travel. This assures maximum service life for the door and its complete counterbalance mechanism.

Every Kinnear Rolling Door is REGISTERED for your protection

Here's "life extension" that protects your Kinnear door investment far into the future: Full details of every door are kept in fireproof vaults. In case of accident or mishap, new parts are always quickly available for any Kinnear Door — no matter how long it has been in use!

Add these advantages to the fact that no other type of door saves so much usable floor, wall and ceiling space—nor combines so much all-metal protection with quick, complete, jamb-to-jamb doorway clearance—than Kinnear Rolling Doors. The result explains why Kinnear Doors are so widely preferred in industrial, commercial and institutional buildings of every type. Write for complete information on Kinnear Rolling Doors!

KINNEAR® ROLLING DOORS
Saving Ways in Doorways

The KINNEAR Mfg. Co.
FACTORIES:
1780-1800 Fields Ave., Columbus 16, Ohio
1742 Yosemite Ave., San Francisco 24, Calif.
Representatives in All Principal Cities

MEEHANITE MEANS BETTER CASTINGS®

Standard construction materials for all Blackmer Vari-Flo pumps is high strength, pressure-tight Meehanite Nodular Iron. It provides the necessary mechanical properties and is less costly than steel, particularly from the standpoint of machining. The intricate rotor shown, a critical internal part subject to high stresses, is cast in type SP-80 to insure top performance under the most severe service conditions.

SOLVE YOUR TOUGH CASTING PROBLEMS WITH MEEHANITE NODULAR

The excellent castability of Meehanite Nodular in combination with exceptional strength, ductility and wear resistance has led to its wide acceptance for intricate pressure castings and many other components which must withstand severe service conditions. The broad range of its utility is further enhanced by inherent production advantages resulting in a reduction of manufacturing costs.

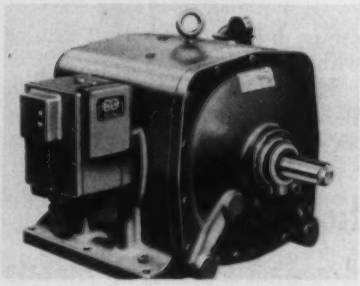
Meehanite Nodular is available in a broad range of properties embracing all current Nodular specifications and including some unique new wear and heat resisting types. When you specify one of the S types of Meehanite Nodular, you can be sure of obtaining castings that live up to specified claims. Meehanite foundries have more than a quarter of a century of experience in handling the essential materials used to convert the graphite in cast iron from the flake form to the nodular which gives this family of metals its unique engineering properties. Meehanite patented quality controls assure uniform dependability regardless of how small or how large the casting.

For complete information about Meehanite Nodular, send for a free single copy of our eight page brochure (B-47-A). Write: Meehanite Metal Corporation, 714 North Avenue, New Rochelle, New York.

MEEHANITE METAL

MEEHANITE CASTINGS ARE MADE ONLY BY MEEHANITE FOUNDRIES.

NEW PRODUCTS and equipment



in large pumps in 0.10 of a second are available. Slow, precisely timed acceleration and deceleration rates up to 3 minutes or slower can be provided.

The DV pumps range 13 to 169 gpm in size for pressures up to 1350 psi and 5 to 108 gpm for pressures up to 2050 and 3000 psi.

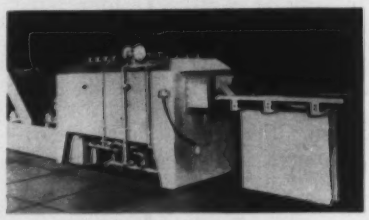
For further information, *write* Oilgear Co., 1571T W. Pierce St., Milwaukee 4, Wis.

Two Types of Heat Treat Furnaces Put on Display

TWO furnaces, a forced convection shaker hearth and the VFC-150, a fast cool vacuum unit, have been developed by Ipsen.

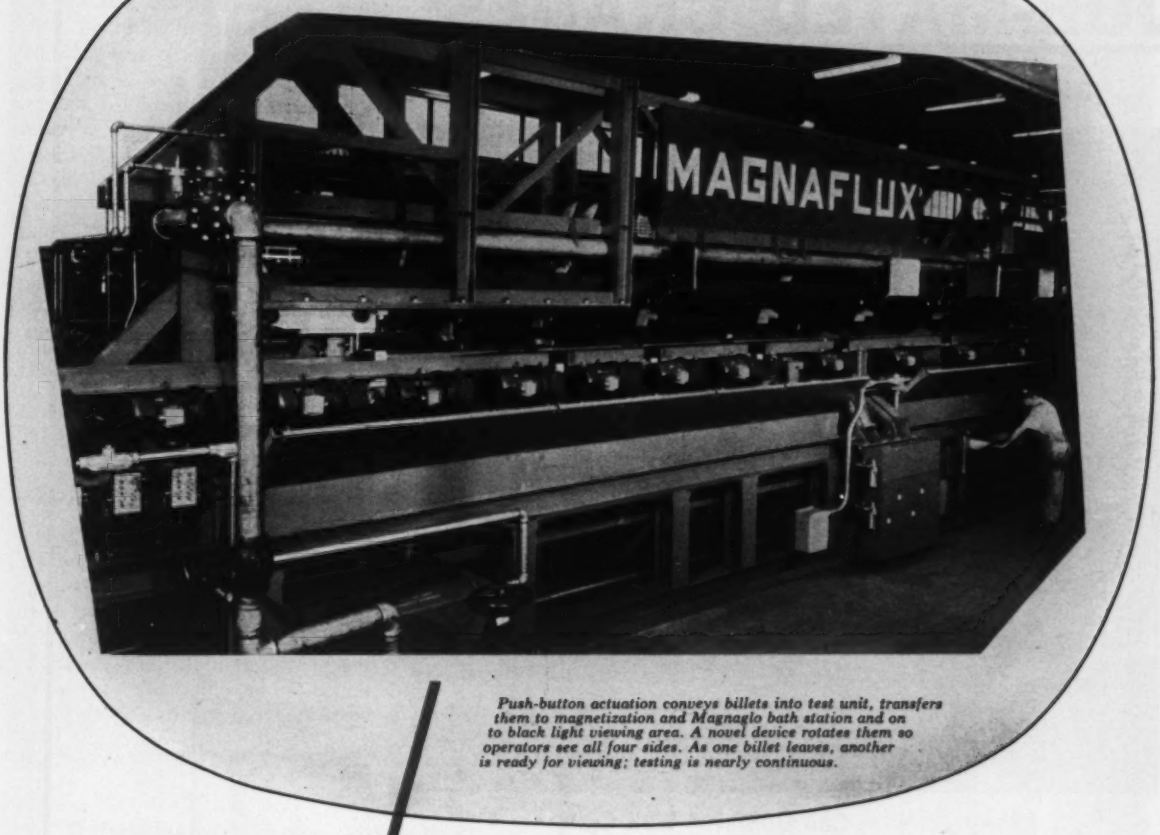
The shaker hearth unit is used for bright hardening, carbonitriding, and light case carburizing. Operating at 1550° F, the furnace has a maximum heating capacity of 1000 lb per hour. Operating costs are at a minimum, says the maker. With an automatic hopper feed, the furnace can carry work through preheat, heating, and quenching stages without further attention by the operator. The unit includes a preheat vestibule, a two zone heating chamber, and a conveyorized quench tank.

The VFC-150 is a high vacuum



Shaker hearth furnace has a maximum heating capacity of 1000 lb per hour

Another Ⓜ Test System at work...



Push-button actuation conveys billets into test unit, transfers them to magnetization and Magnaglo bath station and on to black light viewing area. A novel device rotates them so operators see all four sides. As one billet leaves, another is ready for viewing; testing is nearly continuous.

Testing 4 Half-Ton Billets a Minute

...with Fully Automatic Handling System Engineered and Built by Magnaflux

This latest Magnaglo billet testing unit for seam detection, clearly differentiates between areas needing conditioning and those that do not. This can avoid costly total skinning or peeling; reduce tonnage losses; cut costs; boost output per poured ton. It processes 2⅝" to 4⅛" square billets in lengths to 34'. A single control button actuation programs the entire sequence.

This unit typifies many Magnaflux designed and built testing-handling systems for square billets and tube rounds, and seamless and welded tubing. All are improving quality control, increasing output, and reducing costs. If these advantages and our experience in test-handling design are of interest to you, phone your local Magnaflux Field Engineer or write to Magnaflux Corporation, 7312 W. Lawrence Ave., Chicago 31, Ill.

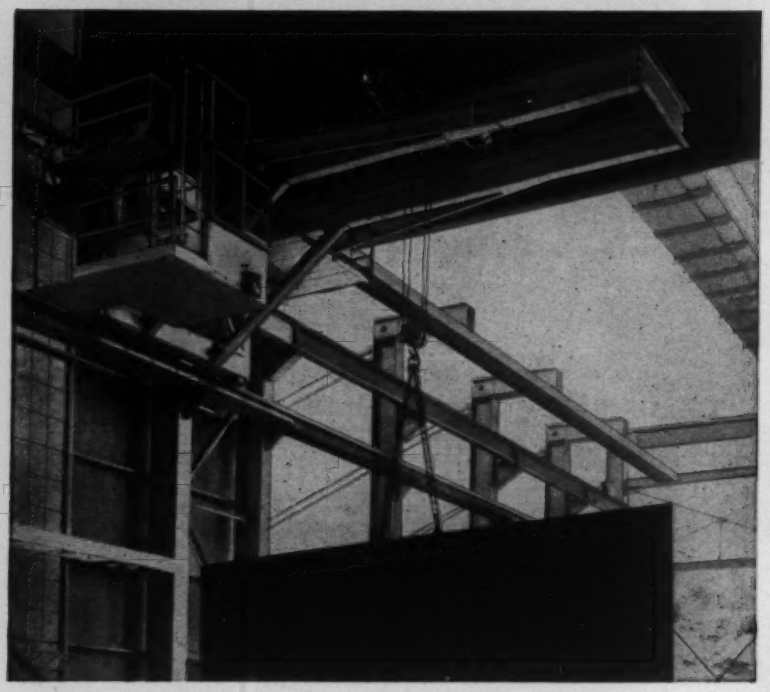
Ⓜ **MAGNAFLUX** CORPORATION
TEST SYSTEMS

A SUBSIDIARY OF GENERAL MILLS

MAGNETIC PARTICLE • FLUORESCENT PENETRANT • ULTRASONIC
EDDY CURRENT • STRESS ANALYSIS • RADIOGRAPHY
DYE PENETRANT • MAGNETIC FIELD MEASURE • THERMOGRAPHIC

SHEPARD NILES JOB-MATED CRANES:

DIFFERENT—because each job is different



Shepard Niles Cab Operated Wall Crane

This Shepard Niles Job-Mated QUALITY Crane was specifically designed for the actual job it is doing. Each component — motors, controls, frame, gearing, trolleys, brakes — was designed and built by Shepard Niles to give the best overall crane performance under unique operating and load conditions.

Your load-moving problem will receive this same careful consideration at Shepard Niles. Even in so-called "standard" applications, our insistence on selecting the right components to meet exact on-the-job conditions, results in a custom-built crane. Care like this in our plant means lower operating costs and increased efficiency in yours.

For the full story on how Shepard Niles Job-Mated Cranes can cut costs in your plant, arrange to have a Shepard Niles representative call at your convenience. Or send for our descriptive bulletin.

Member of Electric Overhead Crane Institute

America's Most Complete Line of Cranes and Hoists

SHEPARD NILES
CRANE AND HOIST CORPORATION

1168 Schuyler Ave., Montour Falls, N.Y.

NEW PRODUCTS and equipment

unit that provides fast heating up to 2400° F coupled with fast cooling. It has a work space 15 in. wide, 24 in. deep, and 10 in. high, a maximum vacuum of 0.1 micron Hg, and an input of 50 kw. Typical work for the unit includes hardening of high speed steels, brazing of stainless, and annealing of refractory metals and special alloys. Total working floor space is 10 x 12 ft.

See them at Booth 161, National Metal Exposition, Cobo Hall, Detroit, or *write* Ipsen Industries Inc., P. O. Box 500, Rockford, Ill.

Dock Leveler Lifts Up to 20,000 lb

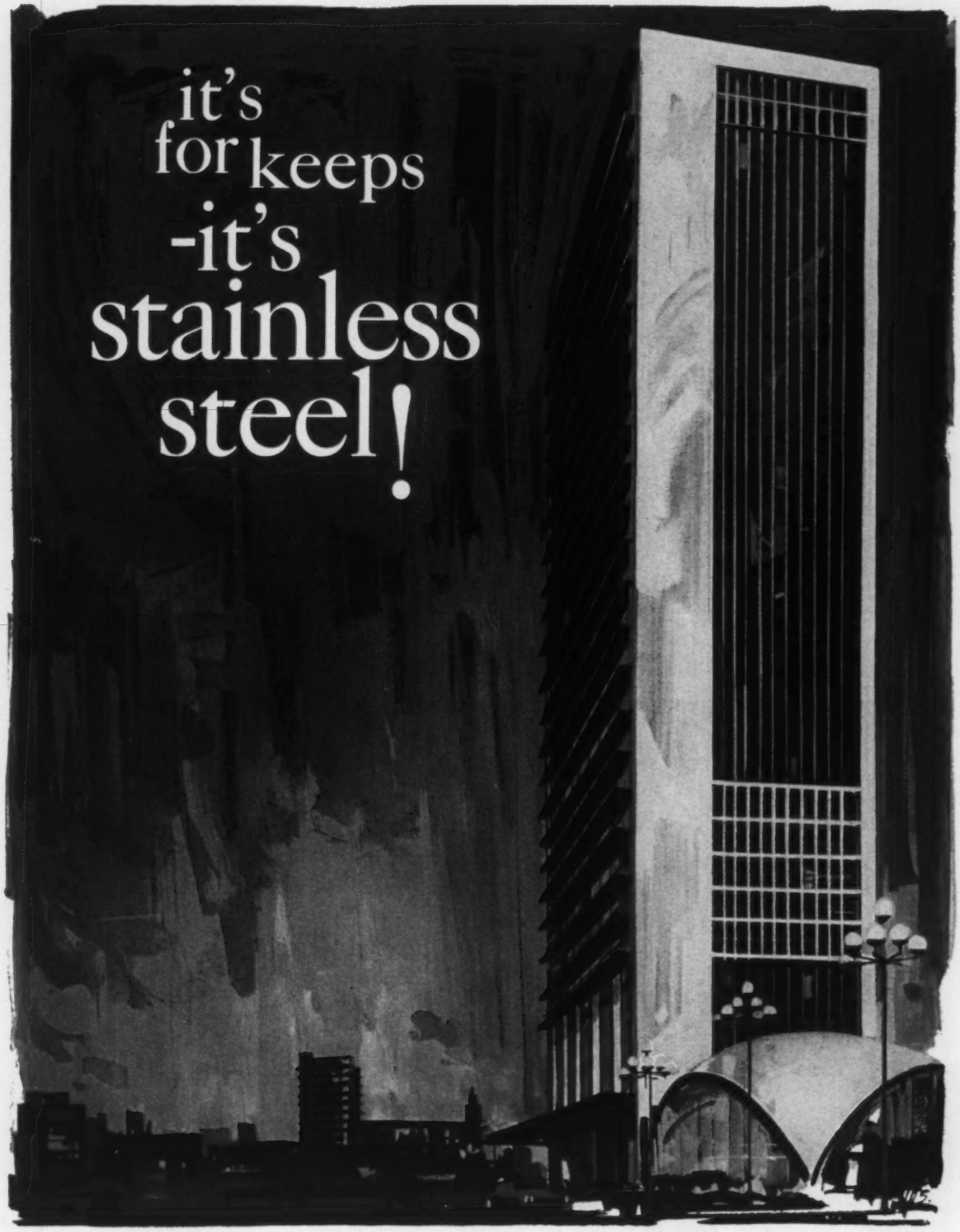
AN AUTOMATIC dock leveler with a capacity of 20,000 lb is available for top, flush, or free standing installation. The truck actuated unit (called Doklevler) provides a height differential of plus 15 to minus 8 in. Permanently sealed lubricated bearings are used.

For further information, *write* Magnesium Co. of America, 155 S. E. 10th Ave., Hialeah, Fla.

Batch Type Drum Washer Cleans Small Parts

MANY small parts can be cleaned with a compact, batch type drum washer developed by Alvey-Ferguson.

Parts for cleaning enter the drum through a chute and are subjected to a high pressure spray. During the washing cycle, the parts are tumbled by a helical spiral in the drum. Cleaning solution, oil, chips, and impurities are drained off through perforations. A predetermined rinse cycle is followed by a



Stainless—the building metal of permanence, economy and beauty.
McLouth Steel Corporation, Detroit 17, Michigan

Look for the **STEELMARK** on the products you buy

McLOUTH STAINLESS STEEL

QUALITY...TODAY'S DIFFERENCE BETWEEN PROFIT AND LOSS!

These are the days of the 12-month warranty . . . extended service guarantees! Never before has Quality been so important.

That's why we suggest you consider BarnesdriL Honing Machines for your surface finishing operations. Because of the quality inherent in these precision-made machines, they impart that "extra" touch of quality to your products at cost-cutting production speeds.

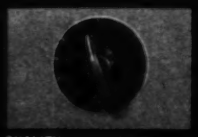
Our detailed story — backed by 35 years of specialization in honing — is yours free! Ask for catalog 200.

BARNESDRIL HONING MACHINES

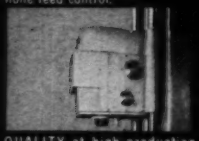
Honing Machines/Production Units
Filtration Units/Drilling Machines

BARNES DRILL CO.

854 CHESTNUT STREET • ROCKFORD, ILLINOIS
DETROIT OFFICE • 13121 PURITAN AVENUE

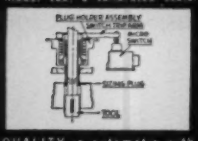


QUALITY is insured with correct hone feeds . . . made possible with this easy-to-set infinite hone feed control.



QUALITY at high-production rates means exact spindle speed rates . . . selected with a flick of the fingers.

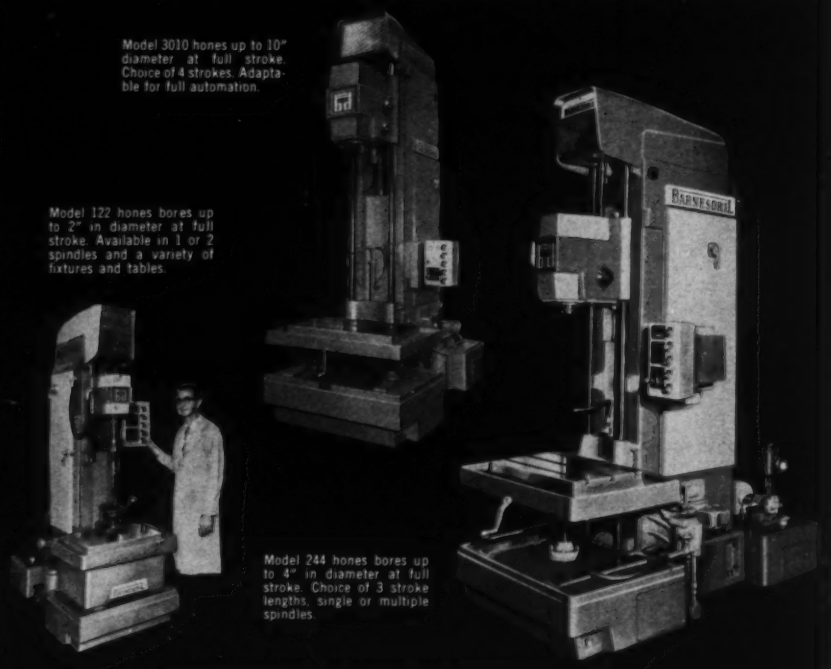
QUALITY results from correct reciprocation speeds . . . easily selected with this dial or, on the Model 122, a calibrated scale.



QUALITY is automatic with Plugmatic® bore-to-bore sizing . . . production size consistency maintained to .0002".

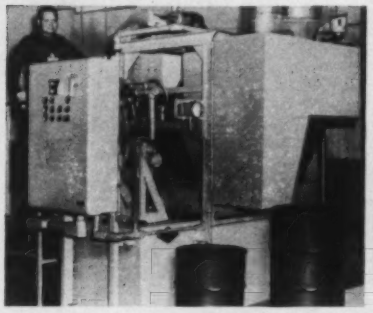
Model 3010 hones up to 10" diameter at full stroke. Choice of 4 strokes. Adaptable for full automation.

Model 122 hones bores up to 2" in diameter at full stroke. Available in 1 or 2 spindles and a variety of fixtures and tables.



Model 244 hones bores up to 4" in diameter at full stroke. Choice of 3 stroke lengths, single or multiple spindles.

OUR FULLY EQUIPPED JOB HONING DEPARTMENT CAN HONE ANYTHING UP TO 25 FEET IN LENGTH. WRITE FOR DETAILS!



drying cycle. An automatic timer controls the sequence, which includes unloading the drum automatically when the parts are clean and dry. A 6 by 10 ft floor space is required.

For further information, *write* Alvey-Ferguson Co., 3131 Disney St., Cincinnati 9, Ohio.

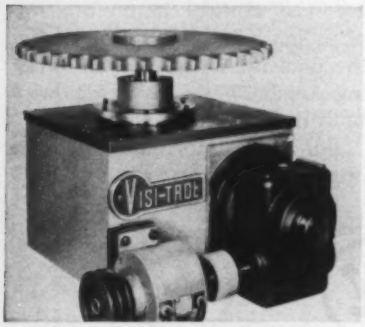
Indexing Drive Combines Accuracy, Compactness

FEATURES of an indexing drive developed by Visi-Trol Engineering include positioning accuracy, compactness, application versatility, and high loading speed torque capacities.

The company says cam and roller components provide a modified, trapezoid acceleration pattern for smooth and shockless indexing.

The standardized drives are available with a wide selection of output shaft angular movements from 4 to 24 stops. Indexing periods are available in 90, 120, 180, and 270 degrees to permit selective cycle timing of index and dwell.

A double extended, input camshaft allows synchronization with tooling, actuators, and cam switch-



bearings and parts

Take the simple, sure, direct route to lower manufacturing and maintenance cost. Design into your product Bunting Standard Stock Bearings. You avoid inventory investment, delays, confusions, production problems by the immediate availability in small or large lots, from local distributors all over America, of hundreds of different stock sizes of completely finished cast bronze and sintered bronze bearings and bars, aluminum bars and Nylon shapes.

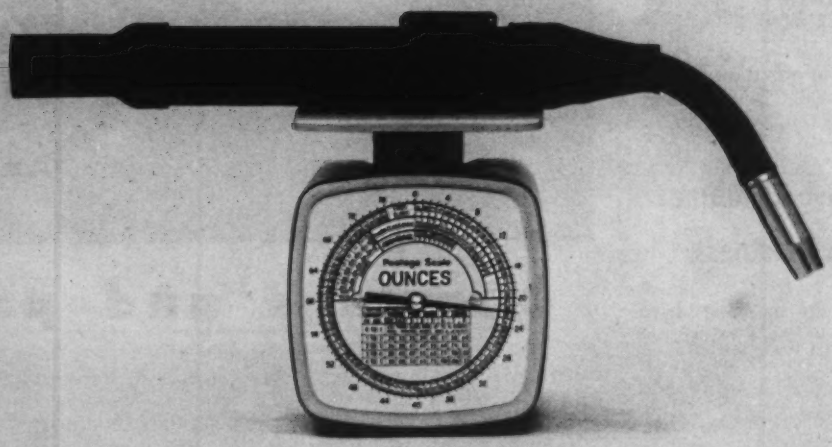
Special design bearings not obtainable from stock can be procured immediately at low cost from Bunting fully equipped machine shops in five industrial centers. The wide range of sizes of Bunting Stock Cast Bronze and Sintered Bronze Bearings makes the alteration of a stock item to a special bearing easy and economical. Bunting Cast Bronze, Sintered Bronze, Aluminum Bars and Nylon shapes provide the materials for special requirements which cannot be made from stock bearings. Your local Bunting Distributor can arrange for such work.

A large staff of bearing engineers in the field stands ready to assist in the use of these Bunting stock products and in the designing of bearings or components for extraordinary applications. Two big, modern plants assure ample production capacity at all times for bearings and parts made from all modern metals and materials.

See Bunting's complete catalog, Sweets Product Design File 11C/BU or ask for Bunting's General Catalog, Form 158; Nylon Catalog, Form 32; Technical Handbook on Bunting Nylon, Form 33; The Technology of Bunting Aluminum, Form 46; Engineering Handbook of Powder Metallurgy, Form 1; Bunting Machine Shop Service, Form 4.

The BUNTING Brass and Bronze Company
TOLEDO 1, OHIO
BRANCHES IN PRINCIPAL CITIES

BEARINGS, BUSHINGS, BARS AND SPECIAL PARTS OF CAST BRONZE, SINTERED METALS, ALUMINUM ALLOYS AND NYLON



22 oz. welding torch— business end of a new system that can clobber your welding costs

This new straight-through torch is the lightest, coolest and most maneuverable you can buy . . . yet it can handle wire at speeds up to 1170 ipm.

It's part of a new Westinghouse system for thin gauge welding that combines the speed and economy of semi-automatic welding with the maneuverability of stick welding.

To back up the torch there's a new wire drive system with a vernier adjustment that permits exact feed control heretofore impossible. The power source for the package is the proven Westing-Arc RCV silicon welder with built-in Dynamic Reactor.

For more information see the opposite page . . .

Westinghouse

New Westinghouse SA-200 Welding System

Here are some of the advantages of the new Westinghouse SA-200 system:

22 OZ. TORCH has an exclusive 360° rotating nozzle that permits the operator to keep the switch in the most comfortable position for any welding job. The torch is air cooled, has a 15-foot cable, handles both mild, stainless steel and aluminum wire. It can be used with CO_2, argon or argon gas mixtures.

PRECISE WIRE SPEED CONTROL obtained from a vernier type potentiometer gives you exact wire speed required—as high as 1170 ipm. Both drive rolls are powered to provide positive wire feed.

HIGH EFFICIENCY 200 AMP RCV WELDER provides lower power consumption than is possible with any comparable system. Controlled output characteristics of this welder, combined with precision wire speed control and a highly maneuverable torch, provides the ultimate in welding gauge size materials.

THE WESTINGHOUSE SA-200 SYSTEM will enable you to have *all* of the advantages of semi-automatic welding and yet retain the versatility of stick electrode welding. All this with as much a savings as 50% in your welding cost. Designed for production welding, there is a continuous feed from a 25 lb. spool of wire, no slag removal, no stub loss, and with the highest deposition efficiency.

READY TO ADVANCE? Call your Westinghouse distributor for a demonstration, or write Westinghouse Electric Corp., Westing-Arc Dept., P.O. Box 2025, Buffalo 5, New York.

You can be sure . . . if it's Westinghouse.

J-10488

NEW PRODUCTS and equipment

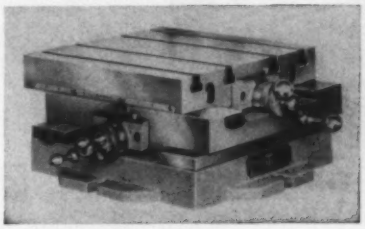
ing interlocks. The camshaft can also be used to actuate the shot pin into the index plate mechanically during the dwell period. That eliminates the need for extra electrical and hydraulic controls.

For further information, *write* Visi-Trol Engineering Co., 12720 Burt Rd., Detroit 23, Mich.

Cross Slide Table Has 12 x 12 in. Working Area

THE Model CS-12 Cross Slide Table does precise positioning on the X and Y axis. The auxiliary unit can also be used with standard rotary tables to obtain X, Y, and rotary motion (by mounting it above or below).

It has a 12 x 12 in. working surface with 10 in. of travel on each slide. Accuracy is within 0.001 in. in the full 10 in. of cross slide travel.



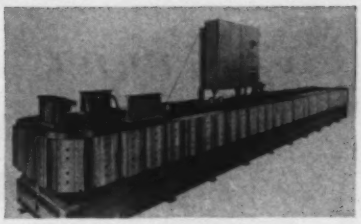
Other features include tapered gibs; adjustable, quick set dials graduated in 0.001 in. increments; stainless steel scales graduated in 0.100 in. increments; gib locks on the cross slides and stops on each cross slide for use with gage blocks or length gages. All surfaces are precision ground.

For further information, *write* Troyke Mfg. Co., 11294 Orchard St., Cincinnati 41, Ohio.

Indexing Machine Chassis Built for Heavy Work

THE Auto-Tran indexing machine chassis accommodates large, extra heavy work without sacrificing cycle time.

The straight line unit is self-contained and includes provisions for



tool mounting and hydraulic tool actuation. The chassis includes a drive motor, hydraulic pump and piping, and electrical wiring ready for tool application.

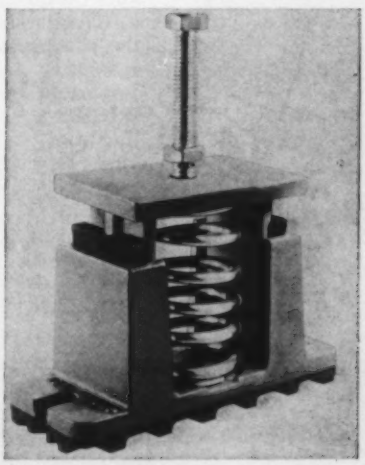
The 30 ft model has 70, vertical, cast aluminum work carriers (each 11½ in. wide, 18 in. high, with a travel of 12 in.). The unit has an electric brake for cycle control that permits infinite adjustment of the dwell portion of the cycle. Index speeds are preset to customer requirements, with minor adjustments possible by pulley selection or adjustment.

For further information, *write* Swanson-Erie Corp., 814 E. Eighth St., Erie, Pa.

Spring Machinery Mount Slashes Installation Time

EQUIPMENT installation time can be cut as much as 50 per cent with spring mountings, says Korfund Co. Other advantages include machinery efficiency and elimination of vibration, shock, and structural noise transmission.

The unit (type LNAA mounting) uses a single, helical coil steel spring as a cushion. It's available in load carrying capacities of 50 to 540 lb. The range is provided by four



a URICK policy . . .

PRODUCTION RUNS* MADE TO MEASURE

**URICK considers 10 pieces and over a production run . . .*

Good castings must measure up more than dimensionally. The URICK policy starts with the design and a complete orientation of what part the casting is to play in the complete assembly. After this product study, URICK is often asked to suggest or recommend the best material for the application . . . URITE Gray Iron or URICK'S Ductile Iron. Then each progressive step, (the pattern, sand, mold, pouring, cooling, heat treating, handling, finishing and shipping) is important toward URICK'S casting success. URICK'S trained team, using the latest modern facilities available, will take your assignment and carry it through to a successful conclusion.

Contact URICK, the foundry that starts with "U" and stays with you. Write for advanced technical data about URITE gray iron castings.

URITE CASTINGS

URICK FOUNDRY

ERIE, PENNSYLVANIA

springs that can be inserted into the housing.

An access port on each side of the housing permits interior inspection, facilitates cleaning, and enables the spring to be changed without dismantling the installation. Other features include an external leveling device (which eliminates the need for shims to level up installation) and soft sponge rubber snubbing chocks which restrict lateral movement without transmitting disturbances.

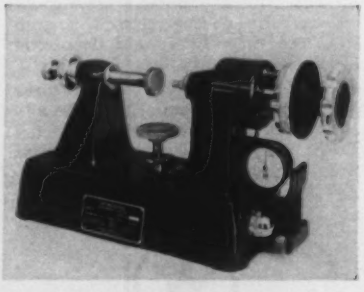
For further information, *write* Shock & Vibration Div., Korfund Co. Inc., 40 E. Cantiague Rd., Westbury, N. Y.

Rockwell Testing Units Permanently Calibrated

TWO models of hardness testers provide Rockwell readings for all standard and special scales. They use loading and penetrators in accordance with ASME and ASTM specifications. The loading mechanism has a beryllium copper spring with practically zero hysteresis and drift. No weights, levers, or knife edges are used. The maker says the setup provides permanent calibration.

The Introdyne H-1 is the first of a series of horizontal models. It weighs only 21 lb. No special installation is required. The model can be used on a moving platform if necessary.

The Magnedyne Model (portable) attaches electromagnetically to ferromagnetic material. It's provided with an adapter shoe which enables testing of flat as well as

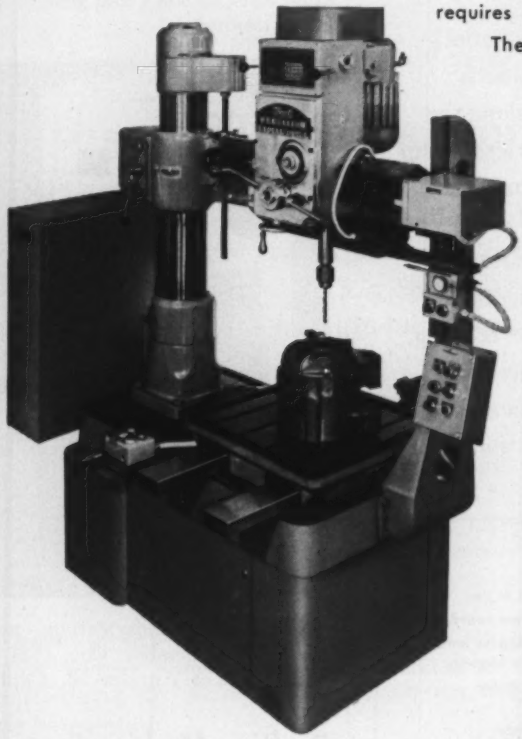


Horizontal hardness tester is portable

SINGER*
NUMERICAL CONTROL

BUY THE COMPLETE PACKAGE...

FOR THE O.E.M. . . . SINGER Numerical Control . . . the most direct approach to point-to-point positioning . . . offers speed, capacity, versatility, a high degree of accuracy . . . and is available at a low initial investment. The system is sold as a package, complete and ready for installation, including the tape reader. It requires only the measuring bars to suit the specific machine. The SINGER system offers a high degree of accuracy, for drilling, jig boring or milling . . . ±.001 inches on a work table and up to 40 inches of travel.



...OR THE COMPONENTS

For the buyer who wants to acquaint himself with the advantages of automatic positioning, rather than buy a complete package, the SINGER system is ideal. Because of SINGER'S modular design, a machine can be furnished with the automatic positioning system only. At a later date, tape control can be readily added with no sacrifice of the original investment. It is important to know, too, that all modules and motors are designed, serviced and built by Diehl Manufacturing Company, a SINGER subsidiary. Call or write for an appointment at the address below.

Shown here is SINGER Numerical Control applied to the new Veetmatic Precision Drilling Machine. This electrically-operated system provides more economical operation at greater accuracies than conventional layout drilling procedures.

Diehl†

DIEHL MANUFACTURING COMPANY
SUBSIDIARY OF THE SINGER MANUFACTURING COMPANY
Finderne Plant, Somerville, New Jersey
Telephone: Randolph 5-2200

*A Trademark of THE SINGER MANUFACTURING COMPANY
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MELTING SUPT. reports:

Soffel's EXOTHERMIC SIDEBOARDS

eliminate Hot Tops... are easy to handle... reduce stripping time to a minimum and give more "out the door" products

Experience proves Soffel's Exothermic Sideboards increase yield all along the line. They require *less* set-up time, *less* track time, *less* storage space, *less* mold inventory. No crane is required—a limiting factor in conventional hot topping. Sideboards give you *more* sound steel and *more* flexibility in operations.

PRODUCT ADVANTAGES

- **Eliminate permanent and conventional hot tops.**
- **Easy, and single, stripping of Big End Down molds.**
- **Sideboards are easily placed in head of mold by one man — crane only necessary on very large ingots.**
- **Longer mold life — less mold cost — less mold inventory to carry.**

Soffel's Exothermic Sideboards increase ingot yield, assure top cut soundness and provide more ton steel out the door per ton of steel in the ingot.

Phone NAtional 5-1571

Pittsburgh Metals Purifying Co.

A Division of Treesdale Laboratories, Inc.

MARS, PENNSYLVANIA

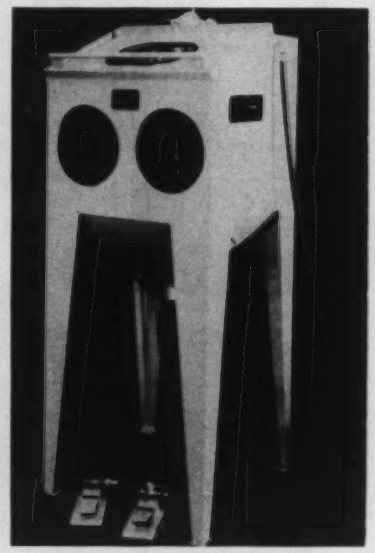
NEW PRODUCTS and equipment

curved surfaces with radiuses of 2 in. and larger. It weighs 23 lb.

For further information, *write* Instrumentation Div., Advance Industries Inc., P. O. Box 128, South Acton, Mass.

Blasting Unit Sets Up For Wet or Dry Media

YOU can get the Peenamatic Model 953 blasting machine in models for wet or dry operation. Air requirements are 25 cfm. The units are constructed of welded, 3/16 in., galvanized steel (hot dipped). The company says the versions for dry or wet media can be used for blending tool marks, removing discoloration, scale, or burrs, and general surface cleaning.



For further information, *write* Metal Improvement Co., 1721 E. 47th St., Los Angeles 58, Calif.

Drafting Machine Features Continuous Path Control

YOU can do drafting, lofting, scribing, plotting, and production tape verification with the Model No. 700, tape controlled engineering machine.

The system accepts the co-ordinate description of a part, which is

Entire girth weld on this Thiokol motor housing is x-rayed in one exposure.

For Thiokol's Redstone Division...

the metal parts countdown starts here

Right in the first stages of missile-motor processing, the Thiokol Chemical Corporation begins its countdown with a check—by radiography—of the soundness of each weld.

Putting power plants together for the nation's space program is intricate work.

So—Thiokol's inspection of metal parts begins with the welds because any seam weakness might well let the bird fly apart.

Also—if the motor uses a solid propellant, radiography provides Thiokol with a quick, sure way to examine the charge for unseen fissures or bubbles that could cause uneven burning and erratic runs.

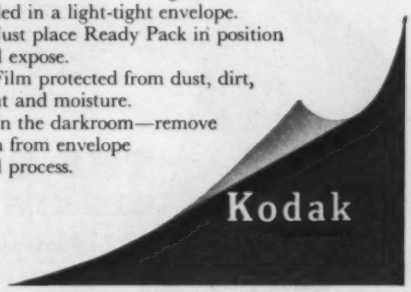
There are many *ways* to use radiography, but the *reasons* remain the same. Radiography saves time and money. It assures a reliable product. You needn't be a missileman to appreciate these advantages.

If you feel your product can benefit from radiography, talk to an x-ray equipment dealer or write us for a Kodak Technical Representative to call.

Arrow points to faulty weld caught on Kodak Industrial X-ray Film.

Now . . . Ready Pack in ROLLS and SHEETS
Kodak Industrial X-ray Film, Types AA and M in 200-ft. rolls (16mm, 35mm, 70mm) and sheets (8 x 10, 10 x 12, 11 x 14, 14 x 17).

- No darkroom loading—film sealed in a light-tight envelope.
- Just place Ready Pack in position and expose.
- Film protected from dust, dirt, light and moisture.
- In the darkroom—remove film from envelope and process.



EASTMAN KODAK COMPANY
X-ray Sales Division Rochester 4, N.Y.

prepared and coded on punched tape by a digital computer and peripheral equipment. The system accurately prepares an engineering drawing up to 60 x 144 in. in a continuous operation. It can produce solid or broken lines on standard types of drawing materials and scribe metallic or plastic coated surfaces with scribing tools in the X-Y plane. Provision can also be made for producing drawings and plots in the X-Z and Y-Z planes.

The unit makes it possible to verify tapes prepared for production machine tools before they are released. Considerable time can be saved by eliminating programing errors. The unit can produce several different scales. Line drawing can be done at speeds up to 120 in. per minute. The unit can also be supplied to verify ½ in. magnetic computer tape.

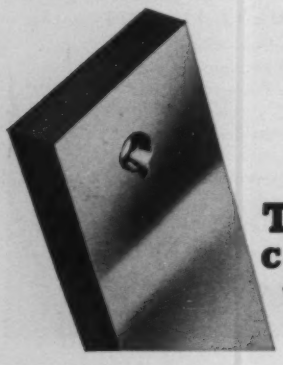
For further information, *write* Ekstrom, Carlson & Co., 1400 Railroad Ave., Rockford, Ill.

OHIO KNIFE CO.
SHEAR BLADES
PASS EVERY TEST

The price of an OK Shear Blade, even with all its superior qualities is strictly competitive. This is possible because the consistent demand for our blades enables us to stock pile economically.

Performance is spectacular as you will discover when comparing OK shear blade runs against others.

Upkeep is minimum. Maximum toughness, superb edge holding qualities mean less downtime for regrinds. There's an OK shear blade for every type of shear made and for every type of shearing.



OK BATTLE AXE grade for shearing up to and including ¼" mild steel or equivalent.
OK DURA-CHROME grade for shearing hot or cold plate up to 1½" or equivalent.
OK UTILITY grade for heavy short runs and heavy plate.
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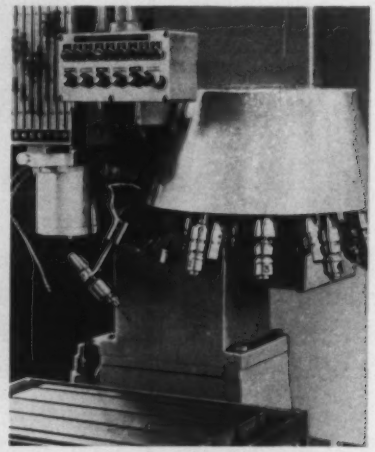
Automatic Tool Changer Has 5 Second Cycle

AN AUTOMATIC tool changer developed for the Edlund-Matic, Model 2N drilling and tapping machine makes a complete cycle in 5 seconds. Tools may be selected out of sequence (by the tape or manually).

The unit carries up to nine cutting tools which can be manually selected during setup. Once selected, the tools are fitted with adapters and seated in the individual storage positions in the rotating matrix. Then the numerical control tape takes over, making tool changes and directing the drilling operations automatically without operator attention.



The manufacturer says the device requires a minimum of clearance between the top of the work and the point of the tool when it is in position. The longer tools require as little as ⅞ in. clearance over the top of the work, and the shorter tools require slightly more.

For further information, *write* Dept. A, Edlund Machinery Co., Cortland, N. Y.

Abrasive Cutting Machine Slices 4 in. Solids

A WET abrasive, cutting machine, Model 102-A, is available with hydraulically operated power feed wheels and work clamps.

The unit is capable of cutting solids up to 4 in. square, pipe and

Now leading steel producer reports

ALEMITE OIL-MIST WITH THERMO-AIRE® CUTS HOT STRIP MILL LUBRICATION COST 90% ON WORK ROLL BEARINGS!

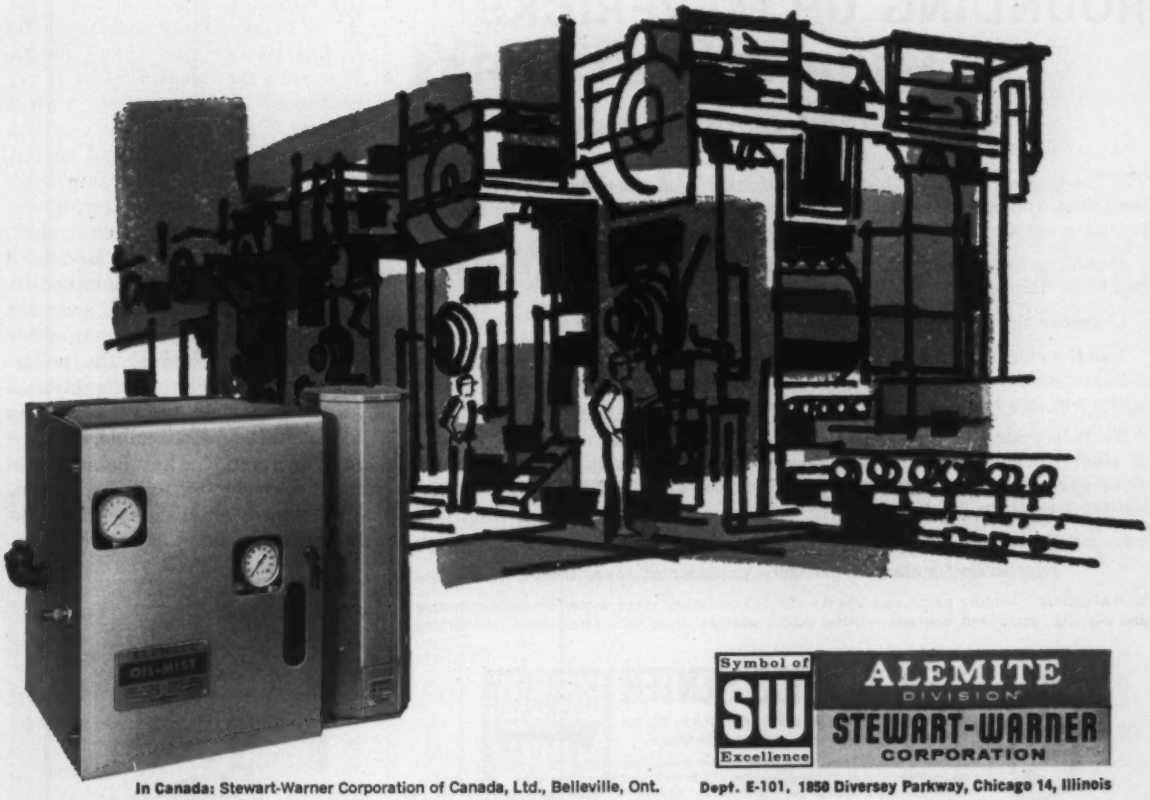
There is no comparison between Alemite Oil-Mist with Thermo-Aire and old-fashioned grease methods!

Take economy. Lubrication savings amount to $32.00 on every turn with Alemite Oil-Mist with Thermo-Aire. Oil-Mist was installed on one stand . . . and is being installed on nine other stands to replace an out-dated system for lubricating 40 roller bearings on an 80-inch hot strip mill. Working 15 turns a week, 52 weeks, these savings will add up to nearly $25,000 a year!

Take efficiency. Alemite Oil-Mist with Thermo-Aire is a fully automatic lubrication system. It applies lubricants constantly, properly, *without losing a minute of valuable production time.* It eliminates expensive packing of bearings with grease and also completely eliminates need to clean bearings of old grease. Its exclusive "Thermo-Aire" feature preheats incoming air—permits atomization of even the heaviest straight mineral oils to supply heavy-duty bearings with the high viscosity lubricants they need for smooth, steady performance.

Alemite Oil-Mist with Thermo-Aire will improve mill operating efficiency...lengthen bearing life . . . cut oil consumption and prevent product spoilage.

Write for illustrated brochure form 37-32, or see your Alemite representative for the amazing story of Alemite Oil-Mist with Thermo-Aire and how you can benefit from it!



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STEWART-WARNER CORPORATION

In Canada: Stewart-Warner Corporation of Canada, Ltd., Belleville, Ont.

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ROUNDING UP MAVERICKS IN YOUR STEEL CORRAL

runs up cost of possession

The cowboy on the overhead crane . . . the range rider on the fork-lift . . . both cost you money when they're working-over piles of steel in storage, rounding-up the right grade in the right size for the job.

Handling and rehandling steel inventory adds cost to your product . . . can even damage steel to the scrapping point.

Consider this cost-reducing answer . . .

Use the complete stocks and first-step processing services of your nearby steel service center just as if they were your very own. Convenience, availability and less handling are augmented by actual dollar-saving economies.

To help your production and cost accounting people figure the *true cost* of steel stocks, ask your steel service center salesman for the booklet, *What's Your Real Cost of Possession for Steel?* Or write to Steel Service Center Institute.

COST OF POSSESSION . . . *to determine your own cost of possession for steel in inventory, consider all these factors:*

Cost of capital: inventory, space, equipment — Cost of operation: space, material handling, cutting and burning, scrap and wastage — Other costs: obsolescence, insurance, taxes, accounting

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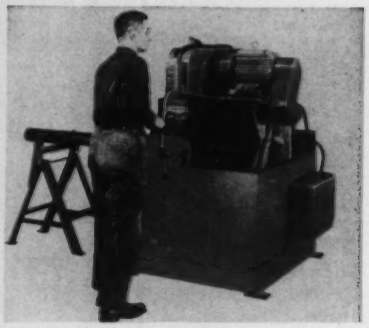
Convenient to every steel user, steel service centers are customer-oriented, technically competent, fully equipped for fast delivery of steel in any type, form, and quantity.

Steel

STEEL SERVICE CENTER INSTITUTE

NEW PRODUCTS and equipment



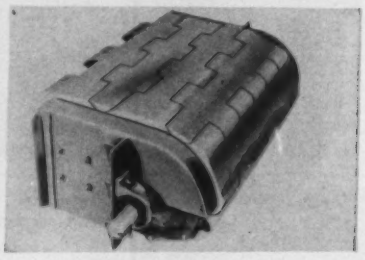
tubing up to 6⅝ in., and channel iron up to 8 in. The maker says it will cut most metals at an average rate of 3 to 4 seconds per square inch.

See it at Booth 514, National Metal Exposition, Cobo Hall, Detroit, or *write* Allison Campbell Div., American Chain & Cable Co. Inc., 929 Connecticut Ave., Bridgeport 2, Conn.

Conveyor Has Continuous Load Supporting Surface

A LINE of conveyor belting and belt conveyors uses a link design. It permits the construction of a flat, continuous, load supporting surface for above floor or flush installations.

The steel belt links (end curved, interlocking, and overlapping) provide an almost smooth carrying surface. Through shafts, at each pitch, extend to join the side drive chains and position them. Intermediate connectors are used to fit over the through shafts. The intermediate connectors attached to the underside of the belt tie the assembly into an integral rigid unit that is easy to assemble or disassemble, says the manufacturer. The belting can handle convex or concave curves. The hinged, interlocking belt maintains closely fitted joints that pre-



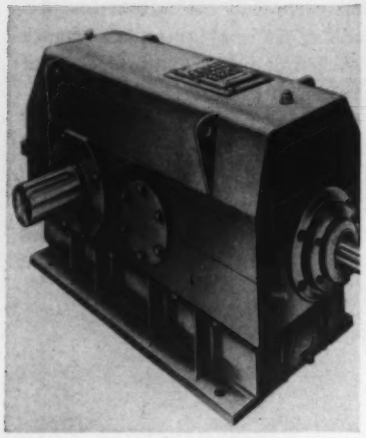
vent tools and assembly items from falling through.

The conveyors can be designed and supplied in any practical width of 12 to 60 in. Belts are available with 6 or 9 in. pitch links.

For further information, *write* May-Fran Co., a division of Fischer & Associates Inc., 1710 Clarkstone Rd., Cleveland 12, Ohio.

Right Angle Drives Rated to 1460 Horsepower

STANDARD gear ratios from 9.39:1 up to 211.0:1 are available in a line of right angle drives. Equipped with high strength fabricated steel housings, the units come in 45 sizes in double and triple reduction types. Horsepower capacities to 1460 hp and torque capacities to 2,210,000 in.-lb can be ordered.

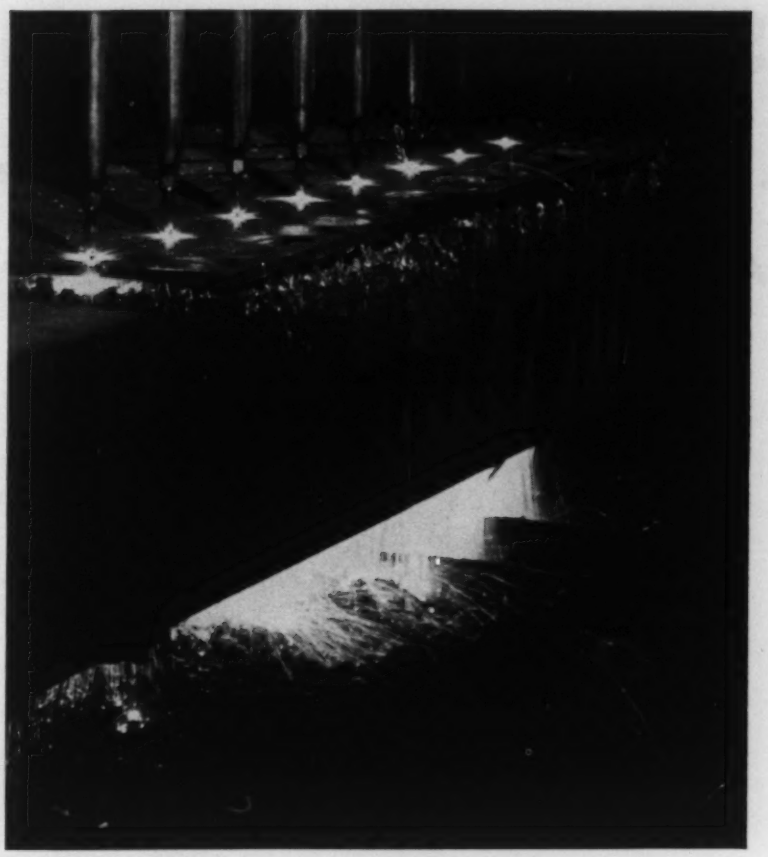


AGMA standard practices are followed on ratings. Heavy duty design is stressed throughout.

For further information, *write* Foote Bros. Gear & Machine Corp., 4545 S. Western Blvd., Chicago 9, Ill.

Dual Safety Valve Monitored Electrically

THE "REPEATING" of machinery due to valve failure can be eliminated with a Dual Safety unit introduced by Fawick Airflex. Both valves are interlocked to prevent repeats in the event of electrical or mechanical failure to either valve. The manufacturer says the valve is



PRE-PROCESSING...

cost-cutting benefit offered by your steel service center

First-step pre-delivery processing is available from well-equipped steel service centers handy to you. Utilize their experienced people and their modern precision equipment to answer your part-time need for costly machinery . . . and men to run it.

Services which steel service centers in your area offer include: burning, precision shearing, slitting, flame-cutting, sawing, leveling and edging.

Pre-delivery processing is backed up by expert steel experience to help you operate economically, yet produce to high standards. Your "cost of possession" of steel is reduced, too. Call on your local steel service center for recommendations, service, and delivery.

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Convenient to every steel user, steel service centers are customer-oriented, technically competent, fully equipped for fast delivery of steel in any type, form, and quantity.

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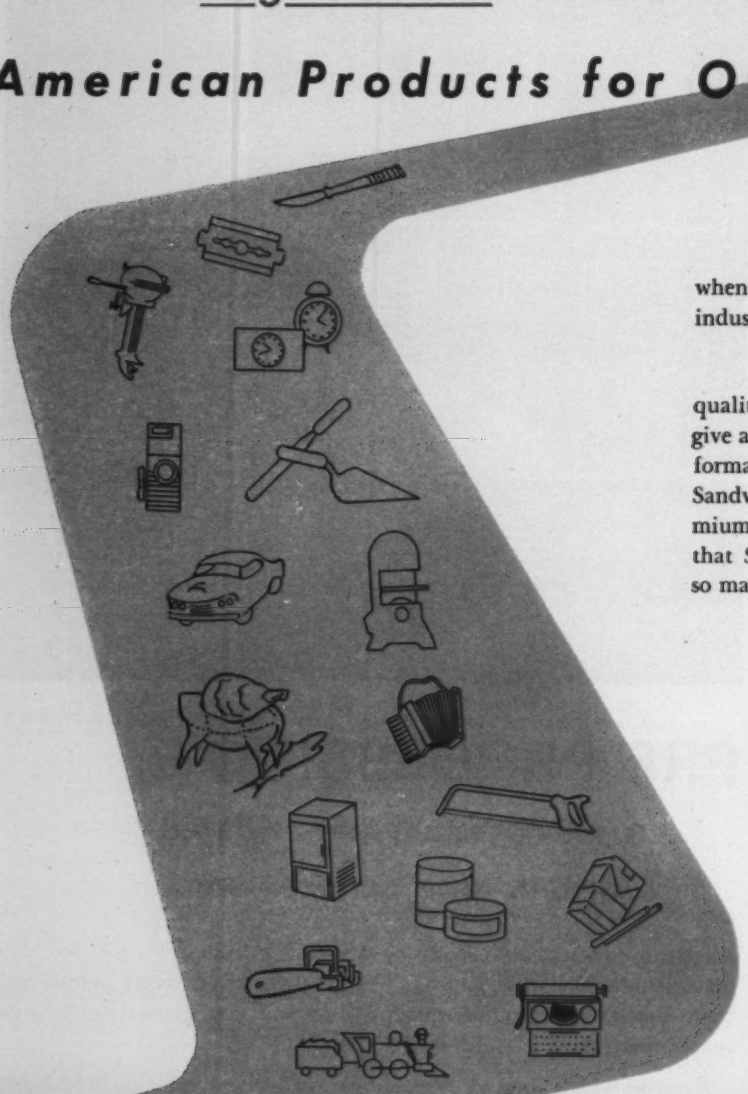
. . . An *Ingredient* of Successful American Products for Over 40 Years



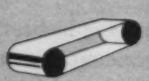
As a matter of fact, *even before* 1919 when Sandvik was incorporated, American industry used Sandvik products.

The reason, then and now, is Sandvik quality—the ability of Sandvik products to give a consistent, predictable, premium performance. It is by this performance that Sandvik has earned its reputation for premium products. It is by this performance that Sandvik contributes to the success of so many American products.

Throughout the U. S. and Canada you'll find Sandvik offices and warehouses conveniently located to put Sandvik quality at your service.

5 SANDVIK QUALITY PRODUCT LINES

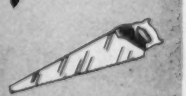
SPECIALTY COLD ROLLED SPRING STEELS, WIRE AND TUBING



STEEL BELT CONVEYORS AND PROCESSING UNITS

CORONANT CARBIDE TOOLING

POWER SPRINGS



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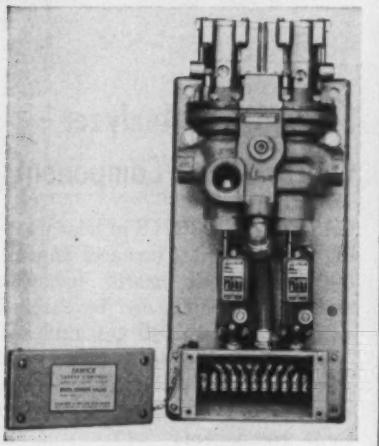


usable with any control system.

The unit (about 25 lb) may be completely disassembled without removing or disconnecting wiring. Wiring is complete to the terminal block and is marked in the junction box. Plug-in type pilot valves and limit switches minimize downtime. Limit switches are easily regulated by a micrometer adjustment on the plunger.

For further information, *write* Fawick Airflex Div., Fawick Corp., 9919 Clinton Rd., Cleveland 11, Ohio.

Low Speed Servomotor Extends Control Horizons

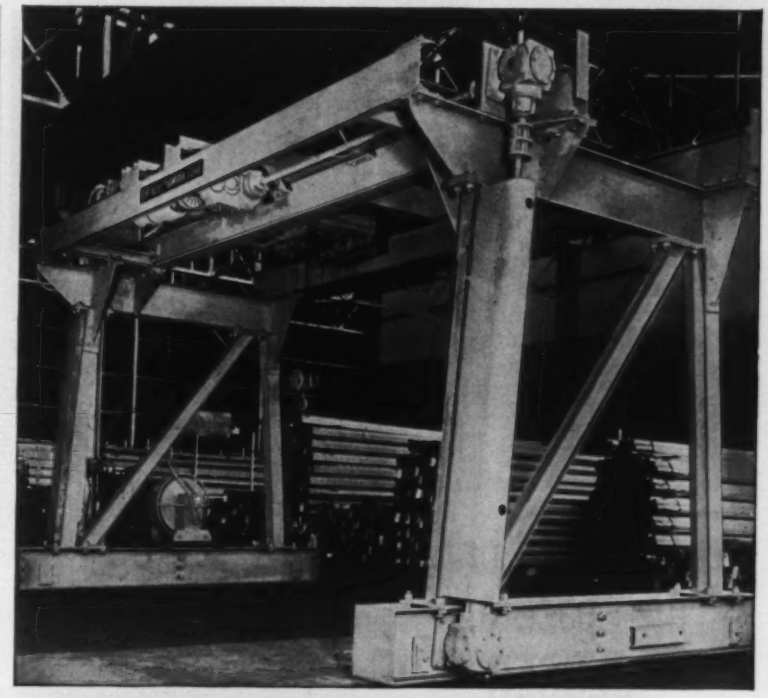
APPLICATIONS which require a control motor with high stiffness, plus a high torque to inertia ratio, extremely fast response, and a wide speed range with low speed limits are suitable for the Acradrive hydraulic motor.

The unit (22 cu in. radial type) delivers 3.52 in. lb/psi torque at full capacity with an efficiency of 98 per cent.

For further information, *write* Cimtrol Div., Cincinnati Milling Machine Co., Cincinnati, Ohio.

Double Coil Stock Reel Takes 24 in. Material

A DOUBLE reel for coil stock can be loaded on one side while the



CHICAGO TRAMRAIL

GANTRY CRANES

At the modern plant of one of the country's largest aluminum companies, Chicago Tramrail Gantry Cranes handle long extruded pieces from a 14,000-ton extrusion press . . . transfer these pieces to other operations throughout the mill.

Fourteen Chicago Tramrail Full Gantry Cranes provide individual handling equipment for individual operations to eliminate waste time waiting for busy overhead cranes. Designed for heavy-duty, continuous service, these Gantries are built with maximum headroom and maximum clearance between legs to operate independently under the large overhead cranes.

For a practical, economical solution to your materials handling problems, see our experienced engineers. Special designs, sound engineering and broad application knowledge qualify us for helpful service.

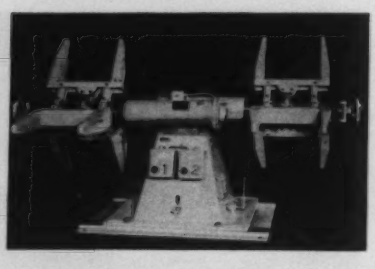
CHICAGO TRAMRAIL DIVISION

Conco Engineering Works, Inc.,

1326 S. Kostner Avenue • Chicago 23, Illinois

other side is in operation. A pedal releases the pedestal lock, allowing the reel head to be swung into position with the new coil correctly aligned for immediate operation. Each side automatically locks when it is in the operating position.

The reels have individual electric brake and rheostat controls to prevent stock overruns and to keep the proper tension on the stock. Each



reel takes stock up to 24 in. wide (2500 lb maximum). The unit can take coils with a maximum outside diameter of 40 in. The inside diameter is adjustable—12 to 23 in. —depending on the model.

For further information, *write* Cooper Weymouth Inc., Stratford, Conn.

Furnace Gas Analyzer Checks Up to 8 Components

GAS COMPONENTS in heat treating furnaces, blast furnaces annealing lines, open hearth furnaces, and gas generators can be checked with the Model 1010 gas analyzer.

The unit (operating on gas chromatography principles) provides direct trend recording of up to eight components.

See it at Booth 1133, National Metal Exposition, Cobo Hall, Detroit, or *write* Research & Control Instruments Inc., Woburn, Mass.

Plasma Surfacing Method Obtains Precise Overlays

A PRECISION method of depositing fused overlays of wear and corrosion resistant alloys has been developed by Linde.

The process, called Plasmarc weld surfacing, involves an overlay metal (or alloy) that is fed as a powder into the Plasmarc torch. Argon gas, used to form the plasma, also shields the surfaced area from atmospheric contamination. Penetration and dilution of the overlay can be precisely controlled. Overlays as thin as 0.010 in. or as thick as 3/16 in. are produced in one pass. More than 6 lb of metal per hour can be deposited at an efficiency of 95 per cent.

See it at the National Metal Exposition, Cobo Hall, Detroit, or *write* Linde Co., a division of Union Carbide Corp., 270 Park Ave., New York 17, N. Y.

Rotary Table, Angle Plate Does Variety of Work

A COMBINATION rotary table and angle plate can be used horizontally or vertically for a wide variety of inspection, layout, and machining applications.

Over-all table diameter is 18 in.

RA 330® brings the space age **CLOSER**

RA 330 supports rocket cases in pit furnace 10 ft. diameter by 30 ft. deep.

RA 330 provides strength at 1900° F. to support, without fear of dropping, a 3500 pound load; resistance to thermal shock of rapid heating and air quenching; resistance to furnace atmosphere and oxidation.

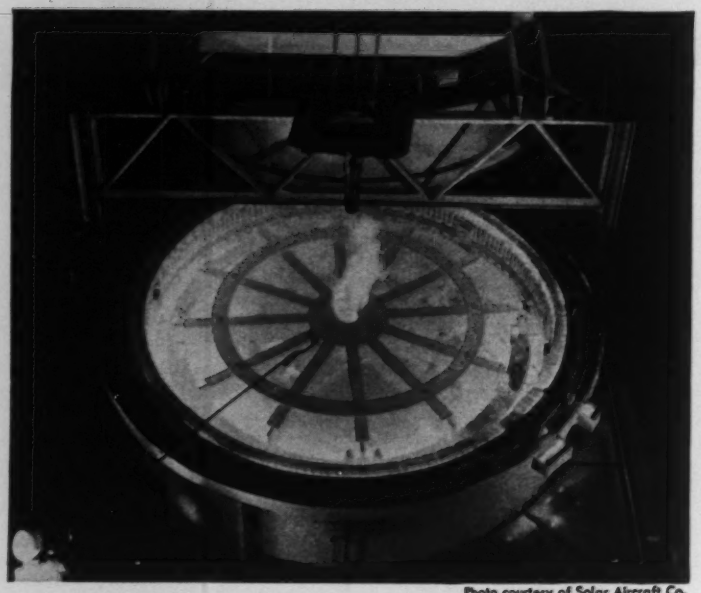


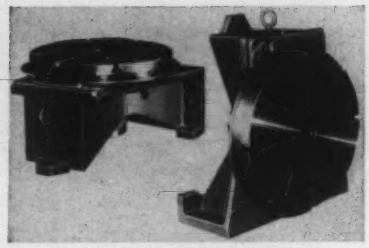
Photo courtesy of Solar Aircraft Co.

Based upon highly successful use of RA 330 in other applications with temperatures ranging up to 2250° F., Solar Aircraft Company selected RA 330 for this critical application.

For best performance specify RA 330 for your heat treating fixtures and furnace parts.

Rolled Alloys Heat Resisting Alloy Specialists will gladly be of service. For technical data—send for Bulletin No. 107.

ROLLED ALLOYS, INC.
Heat and Corrosion Resistant Alloy Specialists
5309 Concord Avenue • Detroit 11, Michigan
330 William Street • South River, New Jersey



The free wheeling face plate rotates 360 degrees with a radial accuracy (by vernier) to 5 minute visual reading. For convenient readings in horizontal or vertical positions, graduations are on a 45 degree angle.

Positioning rings and eight, T slots help loading and clamping of parts. A two point table lock helps assure positive locking. An optional precision centering plug and sine bar arrangement is available for Jo block positioning.

For further information, *write* Machine Products Corp., 6771 E. McNichols Rd., Detroit 12, Mich.

Open Chamber Furnace, Air Dryer Offered

YOU CAN USE the Hayes high purity, open chamber furnace for tool hardening, brazing, sintering, and general heat treating. The maker says temperature response is fast, maintenance of low dew points is easy.

The Model DBB, instrument air dryer is also offered. It's designed to produce effluent dew points of −85° F at air pressures of 100 psig.

See them at Booth 938, National Metal Exposition, Cobo Hall, Detroit, or *write* C. I. Hayes Inc., 811 Wellington Ave., Cranston, R. I.

Machine Finishes, Buffs Flat Parts

FLAT parts such as stainless steel stove, table, and sink tops, brass nameplates, kick plates, and grilles can be buffed and satin finished on the Acme buffing machine.

The unit, an automatic reciprocating, straight line type, has the oscillating work holding fixture mounted on a reciprocating platen. An adjustable buffing lathe does the finishing as the part is reciprocated and oscillated under the buffing wheel. A timer (solenoid operated) controls the cycle length. The fixture oscillates ¼ in. at 200 oscillations per minute. The platen has an adjustable travel actuated by a reversing controller and two limit switches. Platen speed can be varied with a 3 to 1 variable speed drive having a normal range of 5 to 15 ft per minute. The adjustable lathe used on the machine can be equipped for automatic buffing wheel compensation (maintains correct finishing pressure throughout the life of the finishing member).

The length of the machine is dependent on the type and size of the part to be finished.

Other Acme developments include a Model JC, abrasive belt finishing machine and a versatile polishing and buffing machine (vertical).

Both will be shown at booth No. 263, National Metal Exposition, Cobo Hall, Detroit.

The JC abrasive belt finishing machine does flat grinding, deburring, and polishing on parts

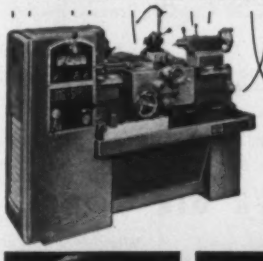
Dalmotor Div., Yuba Consolidated Industries . . . "used in model shop for turning, facing and boring all sorts of experimental parts."

Raytheon Manufacturing Co. . . . "used for turning, facing and boring operations on brass, aluminum and steel workpieces."

Over an extremely wide range of American industry . . . for tooling, production, maintenance and experimentation . . . the Lodge & Shipley 1307 HI-TURN (10") Lathe is making a record of true economy. With literally dozens of big lathe features, the HI-TURN is still priced substantially below many lathes having fewer features, less horsepower and lighter construction.

Turn your attention to HI-TURN. Find out why these and many other lathe users are ordering and reordering HI-TURN Production and Tracer Lathes to replace or supplement larger, far more costly lathes. For complete details, request Bulletin 331, The Lodge & Shipley Co., 3070 Colerain Ave., Cincinnati 25, Ohio.

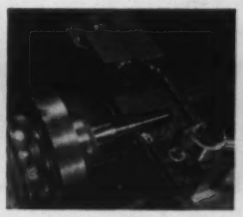
THEY'RE ALL TURNING TO Hi-Turn



. . . your Lodge-ical choice

Lodge & Shipley

Rocketdyne Div., North American Aviation . . . "held OD turning to a tolerance of .0003"."



Leading glass manufacturer . . . "unheard of economy, ease and speed of production" on machining and reworking glass bottle tooling.

Indiana Gear Works . . . has earned a reputation of "excellent for high production."

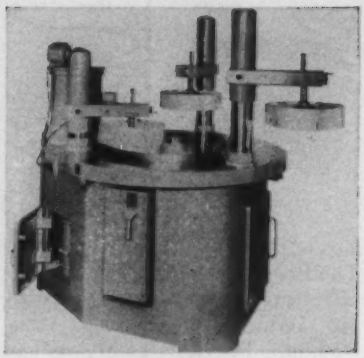
such as bars, strips, blanks, stampings, forgings, diecastings and sand castings. Plastic, ceramic, wood, and rubber parts can also be finished on the unit.

The vertical polishing and buffing unit is set up to simultaneously finish both sides of flat, angular, or irregular shaped parts.

For further information, *write* Acme Mfg. Co., 1400 East Nine Mile Rd., Detroit 20, Mich.

Lapping Machine Designed for Volume Production

VOLUME production of large and small parts is possible on the 36 in., Gyro-Matic, flat lapping machine. Available in pneumatic lift and conventional models, the unit automatically laps and finishes a wide range of materials, including steel, cast iron, bronze, carbides, and quartz. The maker says it has capacity to obtain optical flatness to 1 light band.



For further information, *write* Spitfire Tool & Machine Co., 2931 N. Pulaski Rd., Chicago 41, Ill.

Gas Furnace Handles Wide Range of Work

ATMOSPHERE controlled carburizing, carbonitriding, carbon restoration, normalizing, annealing, and hardening in a temperature range from 1400 to 2000° F are jobs for the AF Casemaster, gas heated furnace.

It's built in five standard sizes with heating chamber dimensions ranging from 18 x 12 x 12 in. to 48 x 30 x 24 in. Production ranges from 100 to 1000 lb of work per hour, says the manufacturer.

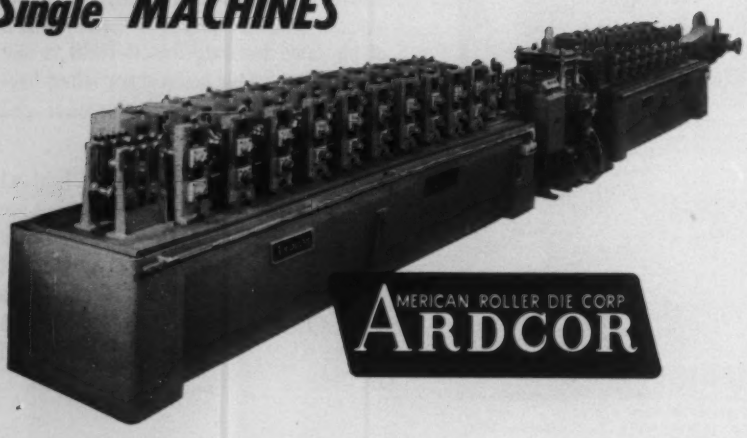
See it at Booth 721, National Metal Exposition, Cobo Hall, Detroit, or *write* Sunbeam Equipment Corp., 168 Mercer St., Meadville, Pa.

Unit Form Grinds Rod Mill Rolls Fast

HERE is a machine designed for fast form grinding of rod mill rolls. The 18 x 96 in. unit can also serve as a heavy duty, plain cylindrical grinder for conventional work.

A crush truing device is mounted on the wheel slide at the back of the wheel. It uses the principle of backup rolls to support the crushing roll during the crushing operation. That eliminates the need for large diameter, expensive crushing rolls, says the company. The unit mounts wheels up to 30 in. in diameter and up to 12 in. wide. The maker says in many cases it will be possible to machine several forms

Automated PRODUCTION LINES or Single MACHINES



ARDCOR Roll Forming Machines can reduce your forming costs on a wide variety of sections.

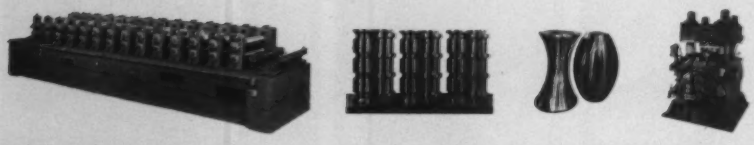
For complete automation on some sections and to eliminate costly secondary operations two ARDCOR Roll Forming Machines may be used with an ARDCOR Cut-Off Press between the two.

Or, a single Roll Forming Machine may be the answer to your cost-reducing program.

Let ARDCOR review your requirements . . .

American **ROLLER DIE CORP.**

29520 Clayton Avenue **Wickliffe, Ohio**



ARDCOR

Single Roll Forming Machines • Complete Automated Roll Forming Production Lines • Lock Seam and Electric Weld Tube Mills for Ferrous and Non-Ferrous Metals • Cut-Off, Pre-Notch Presses • Slitters • Straightening, Pinch, Leveller Rolls • Pipe Rolls, Tube Rolls, Forming Rolls

KEYSTONE WIRE SPEEDS METAL BUILDING ERECTION

Great Lakes Screw Corp. cold heads **Poz-i-seal**®, *the moisture sealing fastener*

Used in the construction of industrial fabricated metal buildings is Poz-i-seal, a sheet metal fastener developed at Great Lakes Screw Corp., Chicago, Ill. It has an indented hex head with Type A point and a hardened steel swivel dome washer, plus rubber seal. Designed to speed building erection, it provides positive seal even when driven at extreme angles.

For this special fastener Great Lakes specifies Keystone's C-1018 Direct Drawn Wire made under closely controlled manufacturing procedures — from open hearth furnace to finished wire.

J. R. Kruizenga, Vice President in Charge of Sales, says, "Keystone Wire flowability and uniform quality keep our high-speed heading machines operating without trouble or delay. Keystone Steel & Wire Company dependable wire deliveries help us maintain an efficient stock control and continuous operation. Keystone service always has been excellent."

When you need a solution to a wire forming problem, let the Metallurgists at Keystone help you develop a wire to meet your most exacting specifications.

Keystone Steel & Wire Company, Peoria, Illinois

KEYSTONE

WIRE FOR INDUSTRY

MADE AT PEORIA, ILLINOIS, U.S.A.

UNIT-COLES
WITH
Gasoline-Electric Drive*

Two UNIT-COLES mobile cranes are used in the International Harvester Tractor Works yard for handling unmachined parts and finished components.

the MOST ECONOMICAL yard crane you can own!

Saves Money through Maximum Space Utilization— Because of its short tail swing, short wheel base, and tight turning radius, a UNIT-COLES has superior close-quarters maneuverability. The high pivotal point of the cantilever-type boom allows *this crane* to work closer to stacks, in less aisle space, and to stack higher. With a UNIT-COLES at work, a smaller yard can handle your storage. Accurate, safe travel along narrow aisles is guaranteed by a reversible steering mechanism which provides "normal" steering wheel movement regardless of position of the crane's super structure.

Saves Money with Gentle Handling — UNIT-COLES' clutchless variable voltage electric transmission gives unmatched smoothness and precision. Each crane function has its own electric motor, supplied by an engine-driven generator. Independent or combination operation of load-hoist, boom-hoist, swing and travel is possible. Controlled power lowering permits the operator to position load accurately, easily and gently.

Saves Money by Saving Fuel—Because of the electric transmission, a UNIT-COLES uses less than half as much fuel as a clutch-operated crane. This machine runs on one gallon of fuel per hour; fuel savings of up to $1,000 a year have been reported by owners. Fuel consumption is reduced because the crane's engine is not governed at a constant high speed; power is developed only as it's needed.

Saves Money on Maintenance — Hundreds of wearing parts found on standard lift cranes are eliminated in a UNIT-COLES. There are no clutches, no change gears, no power-transmitting chains or sprockets. A UNIT-COLES needs only a fraction of the adjustments required by a friction-clutch-type crane.

All this, with Safety and Simple Controls — "Fail-safe" automatic braking and "dead-man" type controls on all crane motions, automatic load-limiting devices, and boom and hook position-limiting switches combine to make a UNIT-COLES the "world's *safest* crane."

A Full-Vision cab increases the operator's view of entire work area. Finger-tip control makes operation as instinctive and effortless as turning on a light switch . . . allows a new operator to become "fully trained" in a matter of minutes.

UNIT-COLES offers a complete line of mobile cranes—ranging from 5 to 55 tons. For details and the name of your nearest dealer, write today.

THE WORLD'S SAFEST CRANE

UNIT-COLES

UNIT CRANE & SHOVEL CORP.
6721 W. Burnham Street
Milwaukee 19, Wisconsin

UC-45

*Diesel-Electric also available.

in the roll simultaneously. The grinding wheel operates at 10,000 sfpm. An automatic, wheel balancing arrangement permits the operator to dynamically balance the wheel on the machine in seconds by merely pushing a button.

The wheel feed mechanism is designed to plunge grind up to 1 in. in depth on the radius of the work (or 2 in. on the diameter). Hydraulic table traverse is provided for traverse grinding on conventional work or to position the table under power.

For further information, *write* Machine Tool Div., Norton Co., Worcester 6, Mass.

Induction Furnace Melts Light Metals and Alloys

ALUMINUM and other light metals and alloys can be melted in a low frequency induction furnace made by Hevi-Duty Electric Co. (under license from Forni Elettrici A. Tagliaferri, Milan, Italy).

The company also announces a portable dew point instrument that provides direct readings without conversion and a tray loaded oven for stress relieving of metals, core baking, and other applications.

See them at the National Metal Exposition, Cobo Hall, Detroit, or *write* Hevi-Duty Electric Co., 304 Hart St., Watertown, Wis.

Furnace Processes Parts, Keeps Them in Motion

AN IMPROVED and larger Automotion furnace has been developed by American Gas Furnace Co. Production capacity of the unit, Model 139-MDR, is 800 lb per hour.

Parts being processed are kept in motion during heating, exposure to atmosphere, and quenching for uniform results. The manufacturer says the unit is particularly advantageous in carburizing and case hardening because it eliminates point of contact case variation caused by continuous contact between the surfaces of stationary or nesting workpieces, or between the work and the conveyor.

See it at Booth 821, National Metal Exposition, Cobo Hall, Detroit, of *write* American Gas Furnace Co., Elizabeth 4, N. J.

Compounds Designed to Improve Lapping Work

A SURFACTANT called Granulaide has been added to Trulap lapping compound, made by Wheel Trueing Tool Co. The maker says it evenly disperses small particles of diamond dust throughout the compound and maintains a high degree of activity among the surface particles. The compound is kept from drying or draining away, and cleaning is made easier.

Lubex, another development, extends the reformulated Trulap. It's added during lapping operations and is said to be fast working, easy to store, and easy to remove from finished surfaces. The compound is produced from diamond powder

Stamco has a new, compact and streamlined design

...Rated 3 cuts of 3/16" mild steel.

Important advances in design and material make this unit the finest at the lowest possible cost.

Stamco is proud to announce the "All Purpose" Slitting and Coiling line. Years of engineering study have resulted in the development of this outstanding slitting equipment. These years of research are reflected in unusual features of this line.

DISTRICT OFFICES, STAMCO SALES, INC.

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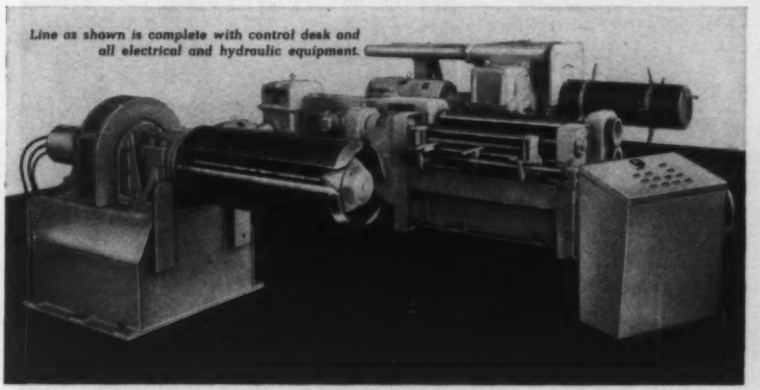
Cleveland 20, Ohio



Line as shown is complete with control desk and all electrical and hydraulic equipment.

Slitting and Coiling Lines • Cut-to-Length Lines • Flying Shear Lines • Power Squaring Shears • Continuous Process Lines • Ferrous & Non-ferrous Mill Equipment

Stamco, Inc.
New Bremen, Ohio, U.S.A

THOMAS Wall Radial Drill
... for drilling plates, angles and beam flanges too heavy to punch
THIS new Thomas tool is a "must" for every structural fabricator who depends on production drilling. It's the Thomas Wall Radial, column-mounted... the handiest and most rugged tool of its kind you ever used!
Ask for Bulletin 320 now!
THOMAS
MACHINE MANUFACTURING COMPANY
PITTSBURGH 33, PA.
the trend is to THOMAS
in Punches • Shears • Presses • Spacing Tables • Benders
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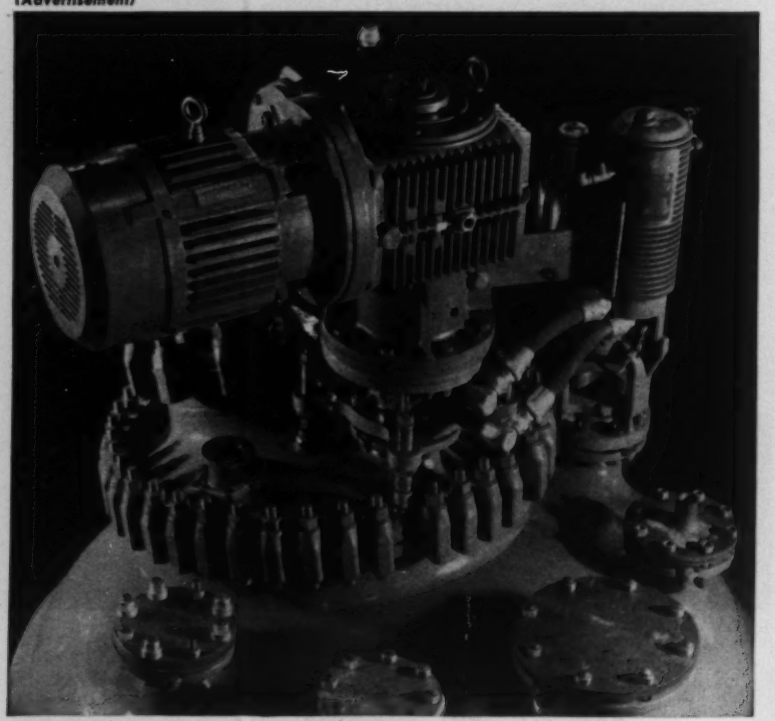
(Advertisement)



ROCHESTER, N. Y.—The Pfaudler Co. reports space savings and reduced maintenance on their new line of TW Agitation Drives for glassed-steel and alloy mixing vessels due to vertical hollow-shaft double-enveloping worm gear reducers by Cone-Drive Gears, Division Michigan Tool Co., 7171 E. McNichols, Detroit 12, Michigan.

NEW PRODUCTS and equipment

graded to U. S. Bureau of Standards specifications.

See them at Booth 350, National Metal Exposition, Cobo Hall, Detroit, or *write* Wheel Trueing Tool Co., 3200 W. Davison Ave., Detroit 38, Mich.

Semiautomatic Welder Handles Many Processes

MULTI-WIRE is a combination welder and matched wire feeder that handles all new semiautomatic processes.

Guns have been developed for each process. When changing processes, the operator selects the appropriate gun and cable assembly and installs the appropriate drive rolls and wire guides.

See it at Booth 720, National Metal Exposition, Cobo Hall, Detroit, or *write* Hobart Bros. Co., Troy, Ohio.

Highly Accurate Spindle Uses Air Bearings

ROTATIONAL accuracy of 1 millionth of an inch is claimed for the externally pressurized, air bearing spindles developed by Professional Instruments Co. Both radial and axial runouts are held to that tolerance.

Two of the spindles are being used in ultra-accurate, roundness testing equipment for Minneapolis Honeywell's electrostatic gyro program.

The spindles, named Zeron, use annular capillaries to control fluid flow through the bearing (conventional pads and orifices are eliminated). They have a radial deflection rate of 2½ millionths per pound and an axial rate of ½ millionth per pound when operated on filtered shop air at 170 psi. Proportionally greater rigidity is possible up to 2000 psi. Air consumption is low—about 2 cfm at 170 psi. The spindles may be operated in any position.

For further information, *write* Professional Instruments Co., 6824 W. Lake St., Minneapolis 26, Minn.

NEW Literature

Write directly to the company for a copy

Tungsten Carbide Hard Facing

The application of tungsten carbide hard facing is described in an eight page bulletin. Kennametal Inc., Latrobe, Pa.

Industrial Metal Cleaning

A 12 page booklet discusses the factors involved in the selection of industrial cleaners, cleaner equipment, and compares the advantages offered by various types. Nox-Rust Div., Daubert Chemical Co., 4700 S. Central Ave., Chicago 38, Ill.

Ramming Mixes

A revised handbook covering methods of installing periclase ramming mixes is available from Kaiser. Designed for use with the installation of Permanente 165 and Permanente 84, the handbook covers methods of mixing and ramming the material and building the forms required for installation in open hearth furnaces. Included also is information on suggested heatup schedules. Kaiser Refractories Div., Kaiser Aluminum & Chemical Corp., Kaiser Center, 300 Lakeside Dr., Oakland 12, Calif.

Molybdenum Properties

A 57 page brochure describes the properties of molybdenum. It contains 45 tables and graphs of properties and specifications and 16 pictures and sketches of products in applications. Included is a section on how to machine and work the metal to finished form. Schwarzkopf Development Corp., 595 Madison Ave., New York 22, N. Y.

Information Searching

An eight page brochure describes the American Society for Metals' electronic system of searching technical articles, documents, and patents on metals, and related subjects for specific mention of any aspect of a subject. American Society for Metals, Metals Park, Novelty, Ohio.

NEW BOOKS

Theory of Metal Cutting, Paul H. Black, McGraw-Hill Book Co. Inc., 330 W. 42nd St., New York 36, N. Y., 204 pages, $7.50

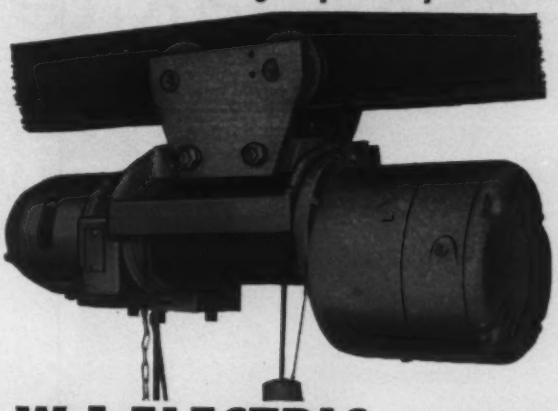
The author has collected and interpreted theories and conclusions concerning what happens at and near the point of a cutting tool. His analysis could be of help in specifying machining operations.

Temperature Measurement in Engineering, Vol. II, H. Dean Baker, E. A. Ryder, and N. H. Baker, John Wiley & Sons Inc., 440 Park Ave. S., New York 16, N. Y., 510 pages, $13

Presented are directions for the measurement of temperatures in situations that

NOW...

a New Member of the Wright Speedway Hoist Family...



The W-1 ELECTRIC...BUILT TO YOUR NEEDS FOR SPEEDY, RUGGED DUTY IN CLOSE HEADROOM LOCATIONS

The W-1 Speedway is a hoist it will pay you to meet without delay. Completely new in design, it can be tailor-made to your exact job requirements for high handling efficiency, low maintenance costs and longer service life. You can choose the W-1 in capacities from 1 to 3 tons...with single, two-speed or variable speed controls... lug or base mounting; plain, geared or motorized trolleys...two or four part reeving. For close headroom application, the WH-1 is available in capacities of 1 to 2 tons. Both models can be equipped with Wright's own built-in overload cut-off for 3-way protection of operator, load and hoist. Hoists are factory tested at 50% above rated capacity before overload equipment is installed.

OTHER W-1 SPEEDWAY FEATURES

Motors—Fully enclosed, ball bearing type. Built to NEMA specifications and rated on basis of 30-minute duty cycle.

Bearings—Anti-friction, precision ball or roller bearings support both ends of all shafts. They are mounted in splash oil lubricated gear chamber.

Motor Brake—External expanding jaw, self-adjusting cam type; operated by solenoid.

Drum—Fabricated all-steel construction with liberal drum to cable diameter ratio to reduce wear and cable fatigue.

ACCO

See your Wright Distributor for complete information about the W-1 or write us at York, Pa. for Bulletin DH-173

WRIGHT HOISTS

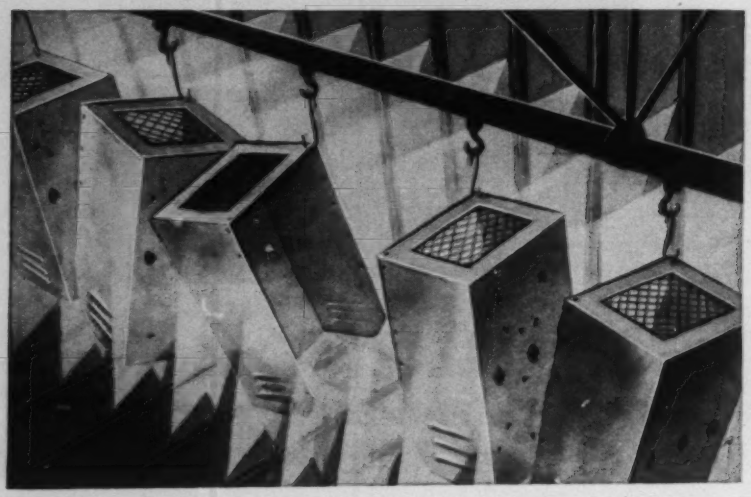
Wright Hoist Division · American Chain & Cable Company, Inc.

York, Pa., Atlanta, Chicago, Denver, Detroit, Houston, Los Angeles, New York, Philadelphia, Pittsburgh, San Francisco, Bridgeport, Conn.

For tough steel cleaning jobs

ask Oakite

OVER 50 YEARS CLEANING EXPERIENCE • OVER 250 SERVICE MEN • OVER 160 MATERIALS



New acid cleaner Oakite 86 gives fast smut removal... good paint grip

Shop smuts on steel parts disappear fast with Oakite 86 in the washing machine. A superior acid detergent, it removes all kinds of soils efficiently—really goes to work on heavily smutted steel. In addition, it forms a conversion coating on steel surfaces to give a good grip on subsequent paint coats ... helps inhibit corrosion.

Oakite 86 also works well when aluminum, zinc, brass and terneplate pass through the washer.

And it is just the latest in a complete line of Oakite materials for spray washing machines. Others include products for high-pressure spraying, for rapid cleaning, for heavy-duty cleaning, for low-heat cleaning, for conversion coatings. Ask the Oakite man which one will work best with your machines, your metals, your specific jobs. Or, write for FREE bulletin. Oakite Products, Inc., 26 Rector Street, New York 6, N. Y.

it PAYS to ask Oakite

OAKITE

over 50 Est. 1909 SCIENCE

years' leadership in industrial cleaning

arise in laboratories, shops, and field locations. Part I is devoted to a discussion and systematic development of basic methods on an engineering-design technique basis. Part II presents a detailed treatment of specific problems of temperature measurement organized by situations and the techniques most suitable for solving them.

Response of Metals to High Velocity Deformation, Metallurgical Society Conferences Vol. 9, edited by P. G. Shewmon and V. F. Zackay, Interscience Publishers Inc., 250 Fifth Ave., New York 1, N. Y., 491 pages, $18

This volume is in two parts. It contains the proceedings of a technical conference sponsored by the Physical Metallurgy Committee of the Institute of Metals Division, Metallurgical Society, American Institute of Mining, Metallurgical & Petroleum Engineers. The first part includes papers on strain rate effects in thin specimens obtained by increasing the head speed on more or less conventional compression or tensile testing machines. The second part deals with wave effects, primarily shock waves.

Radioisotope Applications Engineering, Jerome Kohl, Rene D. Zentner, Herbert R. Lukens, D. Van Nostrand Co. Inc., Princeton, N. J., 562 pages, $16.50

The first nine chapters present basic useful information about nuclear physics, radioisotopes, shielding, legal and safety aspects of radioisotope utilization, calculations for a tracer experiment and measurement, and statistics of nuclear radiation. Chapters 10 to 16 discuss specific radioisotope applications and include many references to work carried out in the U. S. and abroad. The third section of the book, an appendix, includes an updated version of General Electric Co.'s chart of the Nuclides, a discussion of the sources of information on radioisotope applications, a complete table of neutron activation products, and a compilation of useful constants and conversion factors.

The Handbook of Thermophysical Properties of Solid Materials, compiled and prepared by the Armour Research Foundation, Macmillan Co., 60 Fifth Ave., New York 11, N. Y., five volumes, 4300 pages, $90 (available for prepublication price of $75 until Aug. 14, 1961)

Armour originally produced this work while under contract with the U. S. Air Force for use of government contractors in the missile, aircraft, and nuclear science fields. Published data on 12 major properties of solid materials that melt above 1000° F (elements, alloys, ceramics, cermets, intermetallics, polymerics, and composites) are collected in the handbook.

Inventory Control Techniques, R. L. VanDeMark, VanDeMark Inc., P. O. Box 120, St. Clair, Mich., 116 pages, $4.75

The text provides a discussion of inventory control methods. Included are topics such as lot size benefits, shortages and excesses, control without records, a quicker physical inventory, and cycle counting. Mathematical derivations are not used.

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United for Sixty Years

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PITTSBURGH, PENNSYLVANIA

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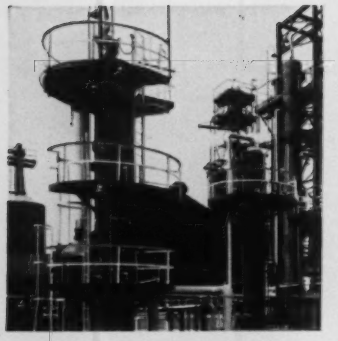

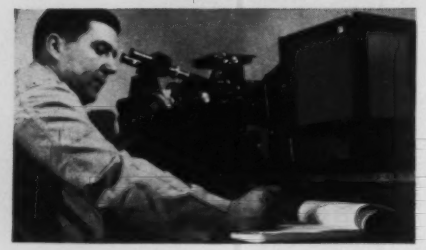

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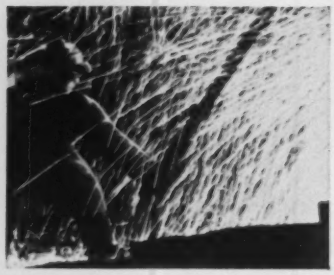

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Shipments Nearing 18 Month High

OCTOBER shipments of finished steel products will approach 6.5 million tons, the largest in any month since April, 1960, despite auto industry strikes.

The shutdowns at General Motors Corp. and Ford Motor Co. have forced steelmakers to hold back shipments and temper their forecasts slightly, but they have not been serious enough to reverse the market's direction. They're merely slowing its momentum. Even if labor peace at Ford is followed by strife at Chrysler Corp., there's little doubt that automotive steel demand will accelerate later this month when the Big Two are in full production. Until then, steelmakers expect the market to hold at its present level—sustained by requirements of the construction industry, appliance makers, shipbuilders, and capital equipment producers.

STEADY UPTREND— Except for a setback in July that was caused by automotive model changeovers and vacations in other industries, the trend in steel shipments has been steadily upward since February. August shipments of 6,139,418 tons were up substantially from July's 5,120,808 tons, and September shipments are believed to have exceeded August's. Shipments for the first eight months of the year: 42.5 million tons (vs. 52.6 million tons in the like period of 1960).

APPLIANCES SPURT— September sales of Norge Div., Borg-Warner Corp., testify to the appliance industry's resurgence. Sales were 59 per cent above those of September, 1960, and the second highest of any September in the division's 34 year history. Judson S. Sayre, chairman, says sales for the first nine months were 34 per cent ahead of those in the like period of 1960.

STAINLESS BRIGHTENS— August shipments of stainless and heat resisting steels (51,175 tons) were the highest of any month since March, 1960. Shipments through the first eight months of this year were slightly less than those of the corresponding period in 1960 (359,238 tons vs. 410,571 tons), but producers believe they'll close the gap by the year's end. Last year, they shipped 578,527 tons. The August upturn reflected better demand from automakers, capital equipment producers, and the construction industry. Since September bookings exceeded August's, there's a good possibility that October shipments will reach the year's highest level. In their preliminary estimates for 1962, stainless marketing men are talking about industry shipments of 660,000 to 680,000 tons. The record year was 1956, when 688,000 tons were shipped.

EXPORTS LAGGING— Exports of steel mill products skidded to 150,000 tons in August. In July, they were 168,617 tons. Totals for the first eight months of the year: 1.2 million tons, with a value of $266.6 million. In the corresponding period of 1960, we exported 2.1 million tons valued at $425.8 million. We're importing about 50 per cent more steel than we're exporting, and there's little likelihood that the trend will soon be reversed. Reason: Foreign producers have upped their capacity and are under heavy pressure to sell the tonnage that their home markets can't absorb.

OUTPUT EDGING UP— Look for ingot production in the week ending Oct. 21 to be slightly higher than the 2,080,000 tons that STEEL estimates the industry poured in the week ended Oct. 14. Output then was off 1 per cent from the previous week's. The drop was caused by the strike at Ford's steel plant and slight curtailments in other districts.

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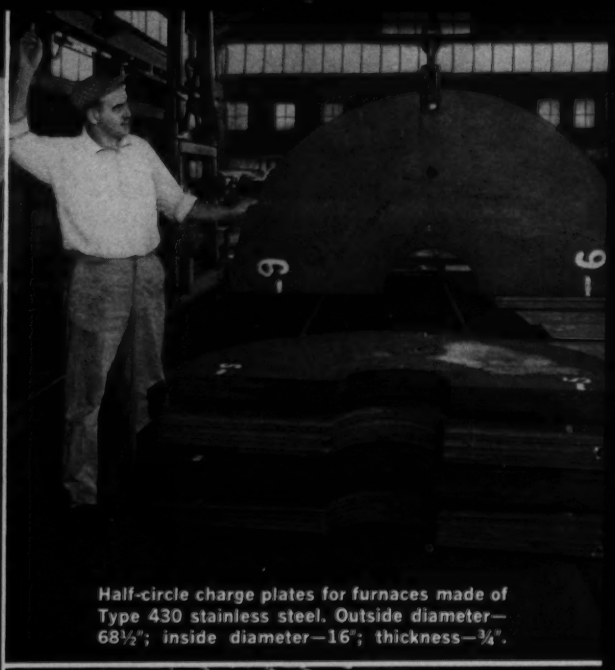
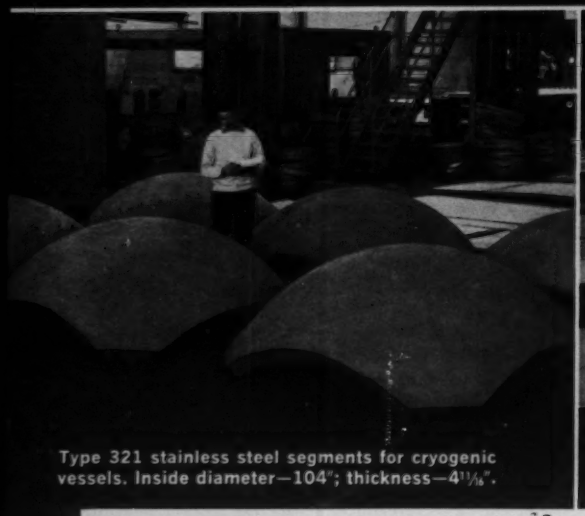
*Current prices were published in the Oct. 9 issue and will appear in subsequent issues.

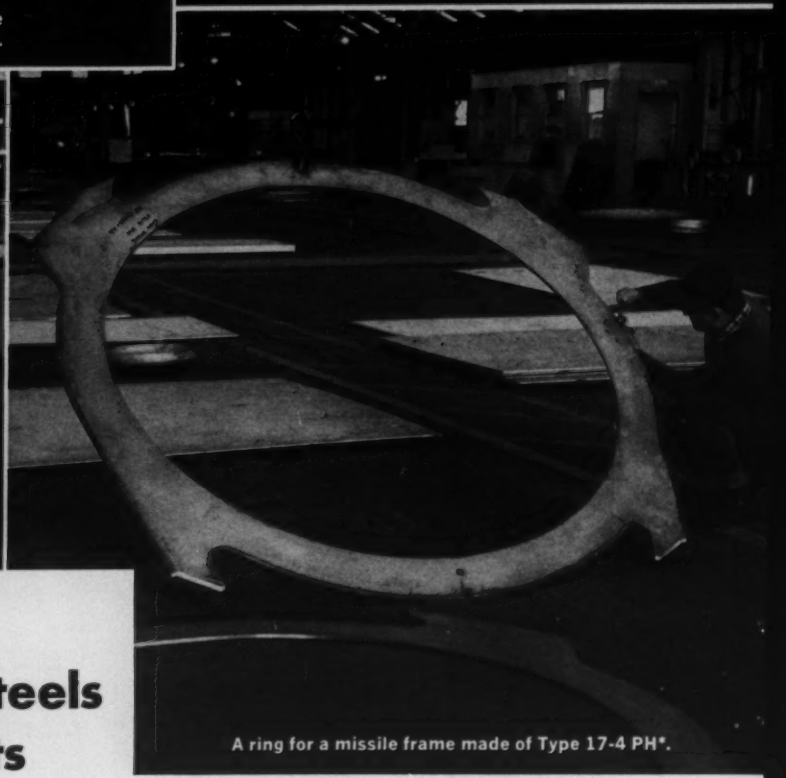
Indexing plate for nuclear storage cask. Type 304. Outside diameter—44⅜"; thickness—2¾".



Half-circle charge plates for furnaces made of Type 430 stainless steel. Outside diameter—68½"; inside diameter—16"; thickness—¾".



Type 321 stainless steel segments for cryogenic vessels. Inside diameter—104"; thickness—4¹⁵⁄₁₆".



A ring for a missile frame made of Type 17-4 PH*.

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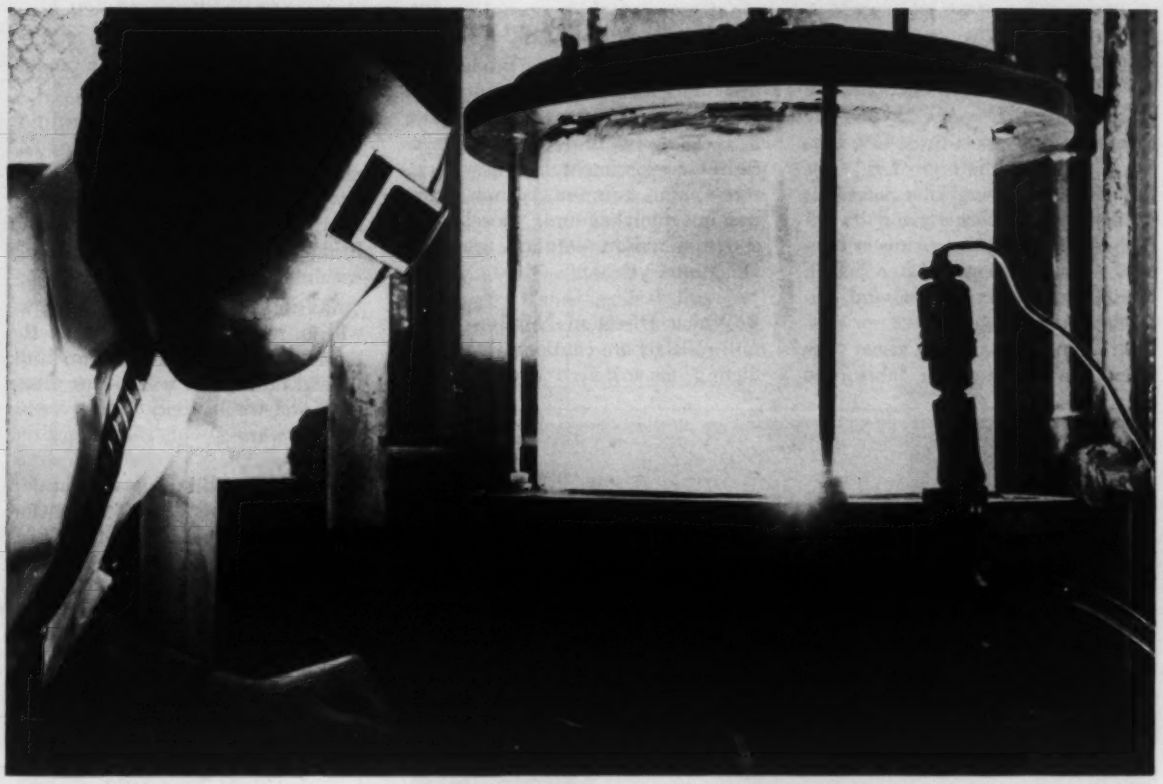


A Chase Brass & Copper Co. metallurgist uses a tungsten arc furnace to melt rhenium-molybdenum alloy compacts into test bars

Copper Is Still King, but . . .

Brass Mills 'Look Hard' at Other Metals

TOP EXECUTIVES in the nation's brass mills are giving a lot of thought to the direction the industry should take. Two conclusions seem to be shaping up:

1. Further diversification into other metals (and nonmetallics like plastics) is highly desirable.

2. Despite the changing complexities of technology and material needs, the brass mills (or copper mills as they prefer to be called) still believe their future lies predominantly with copper base products.

Opinions on the industry's prospects vary from company to company. Yet one fact stands out: There's a rebirth of optimism about the future of copper and copper alloy products. To a large extent, it's due to a recent surge in basic and applied research by the copper producers (see STEEL, Oct. 9, p. 73) and the mills themselves. And the reason is the sharp stepup in efficient marketing practices. Promotion and customer liaison have been increased. Distribution is being overhauled. Market building techniques like value analysis are gaining more attention. Every aspect of the marketing function is under restudy.

• **In Other Materials**—The mills, however, aren't placing all their bets on one horse:

• Anaconda American Brass Co. has been producing small aluminum tubing as well as duplex condenser and heat exchanger tubing made from steel-copper alloy combinations. The company is studying the feasibility of producing carbon steel and Monel tubing. Limited marketing of polyethylene tubing is about to be started.

• Revere Copper & Brass Inc. has a substantial stake in aluminum. It and Olin own Ormet Corp., the country's fourth largest primary aluminum producer (capacity 180,000 tons a year). Revere also produces welded stainless and carbon steel tubing. And it is rolling tantalum.

• Chase Brass & Copper Co. is the country's only producer of rhenium wrought products. The company also fabricates titanium and zirconium on special order; it distributes

stainless steel and aluminum.

• Scovill Mfg. Co. produces aluminum strip in its Mills Div. Scovill is one of four partners building a sheet mill at Oswego, N. Y. (The others are Bridgeport Brass Co., Cerro Corp., and Aluminium Ltd.) The company is studying sales potentials of all forms of plastics, and its adhesives laboratory is looking at laminates and coatings. Other Scovill divisions manufacture steel and aluminum products.

• Bridgeport Brass Co. has gone more heavily into the fabrication of other metals than any other mill. The company refers to itself as: "Specialists in metals production, from aluminum to zirconium." It produces both commercially. It also is working with (either commercially or experimentally) beryllium, columbium, hafnium, indium, magnesium, molybdenum, nickel, rare earths, tantalum, titanium, uranium, vanadium, yttrium.

• **Which Direction Now? — Brass** mill officials are cautious about predicting expansion - diversification plans. Most will say they'll have no hesitation to produce another material if the market looks promising.

Bridgeport Brass Co. will continue with its metals from "A" to "Z" program. "We will expand wherever we profitably can in the metals field," says the company. But Bridgeport plans to expand strictly within the metals field.

"With the proper opportunity, we will go into other metals," says the president of one large Eastern mill. "Metal fabrication will be our prime goal, and we'll supply industry with what it wants."

• **Copper Is Still King**—Expansion into other metals doesn't mean that copper and its alloys will be neglected. In fact, the reverse is going on within the industry. "The industry is determined to create new markets and recapture some of its lost ones," says Carl Woodward, assistant to the president of Anaconda American Brass. "We are taking a new look at marketing, reviewing problems and opportunities in every single market."

One of the most enthusiastic spokesmen for the industry is Glenn P. Bakken, president of Chase Brass: "We are stressing the development of markets for copper and brass. This is where our future lies."

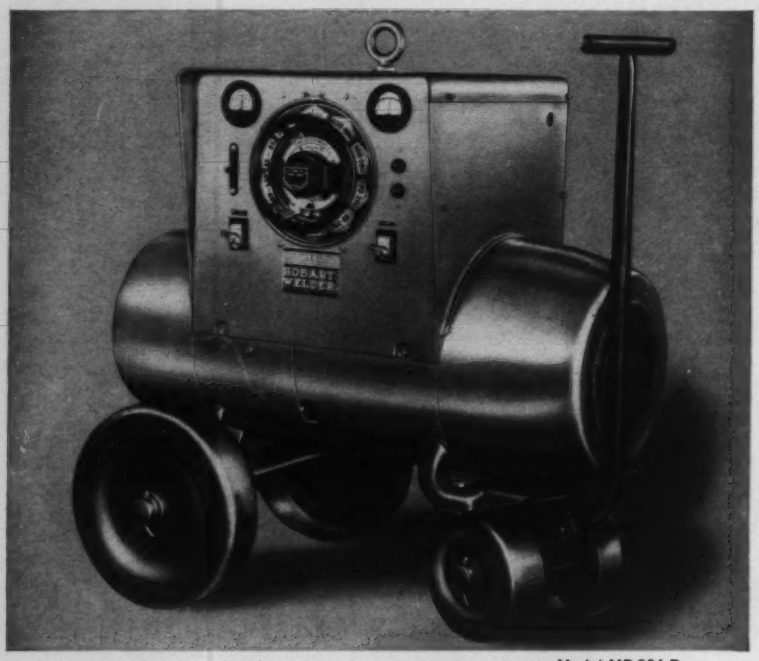
His reasoning: The whole world is going through a technological revolution. Nothing is more basic to a rising technology and a rising standard of living than water and electricity—both are areas in which copper has always been a key metal.

Even in this country, we are only beginning to scratch the surface of applications for copper and its alloys, believes Mr. Bakken.

• **Sales on Plateau**—For the last few years, sales of copper and copper alloy shapes have been only so-so. The industry last had a 2 billion lb sales year in 1956; in 1960, shipments were down to 1.6 billion lb.

This year, sales are on the upswing. Estimates peg shipments around 1.75 billion lb.

Profits on copper products are still poor. The spread between the primary copper price and the selling price of some fabricated products is lower than it was in 1956. Prices have strengthened a little recently, but most observers look for some



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weakness to continue indefinitely because of heavy domestic competition and imports.

If profits on copper products are less than satisfactory, they're even worse on aluminum products, say mill people. One company head says that is the reason the mills aren't doing more with aluminum. Another mill executive goes so far as to label profits on aluminum products "nil since 1959."

• **Wrapup**—Despite heavy losses in some traditional markets in recent years, the mills are optimistic about prospects, particularly in copper and brass products. C. P. Goss, vice president of Scovill's Mills Div., states one reason when he says:

"Metallurgically, brass and copper have properties no other material will ever supplant." Another reason for the optimism is the quiet revolution that's underway within the industry in research, market development, and promotion.

Youngstown's Problems in Three Major Categories

Major economic problems of the Youngstown district fall within three major categories, none of which is "incurable," says the Mahoning Valley Industrial Council's steering committee in a report on a year long business climate survey.

The steering committee, headed by Herman J. Spoerer, Youngstown Sheet & Tube vice president, includes top executives of 14 other Youngstown area industrial companies.

The three categories of distress are: 1. Impact of basic steel labor agreements on fabricating companies and other employers, forcing them to pay 22 cents to $1 an hour more in wages than competitors in areas not covered by steel union agreements. 2. The district's competitive disadvantage resulting from lack of water transport. 3. The city's unfavorable reputation in politics and law enforcement.

Tin Plate . . .

Tin Plate Prices, Page 204

Demand for tin plate has not come up to expectations. At no time has it taxed production capacity, and ordering is reported to be declining seasonally.

Plates . . .

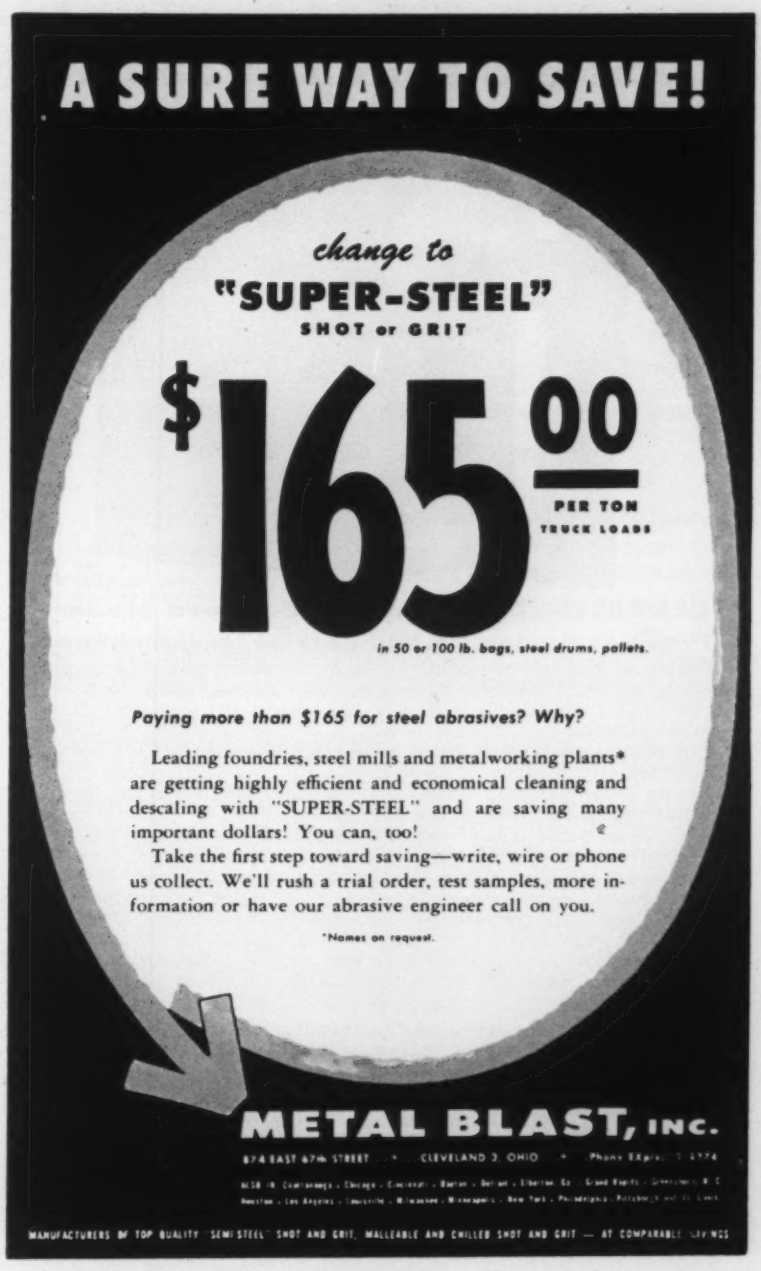
Plate Prices, Page 201

Rising shipwork, including a step-up in Navy specifications, is bolstering plate demand along the Eastern Seaboard. The latest shipbuilding contract in the area involves a tanker for the Atlantic Refining Co., placed with the Sun Shipbuilding & Dry Dock Co., Chester, Pa. Purchase of steel against this contract, however, will not develop until later.

Moore-McCormack Lines are inquiring for six steam turbine powered freighters, estimated to cost around $60 million. They will have a capacity of 12,155 long tons and a speed of 21 knots. Bids will be opened in Washington Dec. 20.

Chemical industry requirements for alloy plate are active. Railroad equipment inquiry remains spotty.

Deliveries of hot carbon plates continue to be available in two to four weeks and alloy plates in about five weeks.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A Texas importer is bringing in 2500 tons of 3/16 and ¼ in. plates from South Africa.

Steel Bars . . .

Bar Prices, Page 201

Although demand for commercial steel bars is more active than it was a few weeks ago, it is falling short of expectations. That's due primarily to the unsettled labor situation in the automotive industry.

September shipments of hot rolled were about on a par with those in August, which was the highest since May, 1960. Automakers appear to have bigger steel inventories than had been estimated by suppliers, or they don't intend to step up their production as rapidly as some market observers have been predicting.

Sheets, Strip . . .

Sheet & Strip Prices, Pages 203 & 204

The unsettled labor situation in the automotive industry has taken the pressure off demand for sheets. There's enough miscellaneous buying, however, to provide further slight improvement in over-all activity. Generally, the sheetmakers think demand will level out until after the automakers begin releasing tonnage already on order books.

Except for galvanized sheets, it now appears unlikely there will be full production in any of the flat rolled grades in last quarter. Deliveries on galvanized still run six to eight weeks, with promises on hot rolled two to three weeks, cold rolled two to five weeks, enameling stock and electrical sheets four to five weeks.

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Fewer Barrels and Drums Shipped During July

Shipments of steel shipping barrels and drums in July totaled 2,495,589 units, off 12 per cent from the preceding month and down 2 per cent from July, 1960, reports the Census Bureau. The total for the first seven months of this year was 18,066,957 units vs. 17,796,301 in the same 1960 period.

Steel shipping pail shipments in July totaled 6,318,191 units, down 16 per cent from the preceding month's total but up 7 per cent from that in July, 1960. Shipments for the first seven months this year were 44,638,635 units against 42,820,633 in the same period last year.

Tool Steel . . .

Tool Steel Prices, Page 206

Shipments of tool steels (excluding hollow drill steel) increased sharply in August, totaling 6645 net tons vs. 4848 in the preceding month, reports the American Iron & Steel Institute. Shipments in August, 1960, amounted to 5716 tons.

In the first eight months this year, the total movement was 50,237 net tons, off more than 13,400 tons from the 63,649 tons moved in the same period of last year.

Tubular Goods . . .

Tubular Goods Prices, Page 206

Seasonal slackening is noted in the tubular goods market, particularly in pipe for building and construction. Oil country goods aren't moving as fast as they were during the summer, but the outlook for the coming months is still good.

Rotary oil rig operations in the U. S. and Canada dipped in the latest week of record (that ended Oct. 2) reports Hughes Tool Co. The U. S. had 1830 rigs operating, off 24 for the week but 73 ahead of the like week a year ago. Canada had 162 rigs engaged, off 11 for the week, but 15 ahead of a year ago.

Gas Appliance Industry's Steel Needs Seen Rising

The gas appliance industry will buy at least 3.9 million tons of steel and 200,000 tons of cast iron in the next five years, predicts William G. Hamilton Jr., president, Gas Appliance Manufacturers Association, and president of the American Meter Co., Philadelphia.

He made the prediction at the annual convention of the appliance association in Dallas. The association's members used 800,000 tons of steel and 35,000 tons of cast iron in turning out about 9 million gas appliances last year.

In the next five years, Mr. Hamilton sees a market for some 50.7 million units of home equipment, and says the larger business volume will make the industry a bigger steel buyer despite a trend toward lighter and more compact appliances.

Iron Ore . . .

Iron Ore Prices, Page 208

Iron ore imports this year are running at a noticeably slower pace than those a year ago. June imports of 2,185,540 gross tons brought the total for the first six months of this year to 10,014,304 tons. That compares with imports of 17,360,427 tons in the first half of 1960. The breakdown of imports for June and the first six months this year:

Iron Ore Imports—June, 1961
(Gross tons)

Source	June, 1961	January-June, 1961
Brazil	.....	351,706
Canada	1,190,757	1,901,071
Chile	209,536	1,095,613
Liberia	79,780	351,681
Mexico	15,339	54,343
Peru	80,900	576,564
Sweden	7,580	19,780
Spain	.....	100
Union of South Africa	.....	11,090
United Kingdom	.....	2,116
Venezuela	601,648	5,650,230
Total	2,185,540	10,014,304

Pig Iron . . .

Pig Iron Prices, Page 207

Buying of merchant iron is expanding moderately. October volume should exceed September's, and further betterment is expected in November.

Alan Wood Steel Co. blew in the second of its two blast furnaces at Swedeland, Pa. Wickwire Spencer Steel Div., Colorado Fuel & Iron Corp., has shut down a blast furnace at Buffalo for rebuilding. Youngstown Sheet & Tube Co. will install equipment for injecting natural gas into its No. 4 blast furnace at its Campbell Works to boost iron output and cut coke consumption.

Steel Shipments Register Sharp Increase in August

Finished steel shipments in August totaled 6,139,418 net tons, up sharply from the 5,120,808 tons moved in July and 5,071,953 tons shipped in August, 1960, reports the American Iron & Steel Institute. The total for the first eight months was 42,488,062 tons vs. 52,633,983 in the same period last year.

The principal products shipped during August included: Cold

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New portable weigher and loader eliminates the ordinary truck delays for separate weighing. Hopper parts subjected to severe abrasion are made of USS "T-1" Steel.

USS "T-1" Steel in portable weigher hoppers increases service life 65%... reduces weight 50%

There is something new under the sun in Boise, Idaho. A portable weigher, called the Shrock Speed-Weigh, holds promise of revolutionizing bulk-materials weighing. This unit, designed by the Western Conveyor Company, will weigh and discharge a six-ton load from hopper to truck in 10 seconds. It will handle rock, gravel, coal, iron ore and other aggregate materials.

One of the big problems the designers faced was finding a type of steel that would permit reduction in weight, for mobility, yet be tough enough to take extreme abrasive punishment. U. S. Steel was asked to help. Tests proved that USS "T-1" Constructional Alloy Steel would solve the problem.

To assure long maintenance-free operation in spite of high tonnages and extremely abrasive conditions, parts of the surge-hopper, the weigh-hopper and the gates were lined with ¼" plates of USS "T-1" Steel. A total of 2,188 pounds of "T-1" Steel was used for these applications resulting in a weight saving of 50%. Liner life was increased by 65%. In addition to the "T-1" Steel used, 14,680 pounds of USS structurals, angles, channels, sheets, plates and bars go into each bulk weigher also.

Other equipment where USS "T-1" Steel saves money. For power shovel and dragline buckets, scrapers, bulldozers, truck liners, equipment haulers—wherever extra high strength is needed with impact abrasion resistance and weldability—USS "T-1" Steel results in longer life and freedom from breakdowns. USS "T-1" Steel and the new lower priced "T-1" type A Steel can be furnished to a minimum yield strength of 100,000 psi, or a minimum hardness of 321 Brinell, depending on application. USS "T-1" Steel can also be furnished to 360 Brinell. All of these tough, weldable steels can reduce weight and increase the strength and life of your equipment. Call your local Steel Service Center for more information. Or, for the name of the distributor of USS "T-1" Steels nearest you, write to United States Steel, 525 William Penn Place, Pittsburgh 30, Pennsylvania. USS and "T-1" are registered trademarks.

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United States Steel

rolled sheets, 1,065,301 net tons; hot rolled sheets, 632,438; hot rolled bars (including light shapes) 598,-532 tons; electrolytic tin plate, 526,-276; plates, 495,394.

Major market groups receiving direct mill shipments during the month were: Warehouses and distributors, 1,138,267 tons; automotive, 1,157,532; construction (including maintenance) 972,447; containers, packaging and shipping material, 653,280; contractors' products, 380,256 tons.

Distributors . . .

Prices, Page 207

Bookings by steel service centers are tending upward. October may rank as one of the better months of the year. But demand is not rising as rapidly as had been expected.

The price situation remains unstable. Buyers are keen to take advantage of bargains. Imports appear to be of less concern than they were earlier in the year.

Steelmaking Operations Decline

STEELMAKING operations have turned downward—closer to consuming needs. Steel mills do not have the volume of orders they expected a month or so ago. Operations in October will probably be a little better (possibly 5 per cent) than those in September. But they will fall short of the 10 to 15 per cent gain expected before demand was weakened by strikes in the automotive industry.

Production for the week ended Oct. 14 is estimated at 2,080,000 tons, a drop of 1 per cent from the preceding week's total of 2,102,000 tons.

● **Chicago**—The ingot rate for the week ended Oct. 14 is estimated at 74 per cent of 1960 capacity, off 1 point from the previous week.

● **Detroit**—Output dipped slightly during the week ended Oct. 14 to about 62.5 per cent of 1960 capacity. The decline reflects a holdup of automotive orders.

● **Youngstown** — The steel ingot rate dropped 2 points to 66 per cent of 1960 capacity during the week ended Oct. 14. Youngstown Sheet & Tube Co. took off two open hearths at the Campbell (Ohio) Works. Republic Steel Corp. took off an open hearth and one turn at its bessemer plant. U. S. Steel Corp. added an open hearth at its Ohio Steel Works. The steel plants are getting "hold" instructions from General Motors Corp. and Ford Motor Co. and are having trouble getting long range schedules on shipments. Finished and semifinished products for automakers are piling up at warehouses.

● **Buffalo** — Steel production is holding steady at about 61 per cent of 1960 capacity. Bethlehem is using 19 of 35 open hearths; Republic Steel, four of nine; Wickwire Spencer, two of three.

● **Philadelphia** — The production trend in the Northeastern district continues slightly downward. Output in the week ended Oct. 7 showed a drop of 5 points in the AISI index to 108.

● **Los Angeles** — Production increases during the week ended Oct. 14 at some leading mills were more than offset by declines at other mills, pushing the district's operating rate down 1 point to an estimated 83 per cent of 1960 capacity.

● **Birmingham** — The steelmaking rate for the Birmingham-Gadsden-Atlanta area of the Southern district rose ½ point to 69 per cent of 1960 capacity for the week ended Oct. 14.

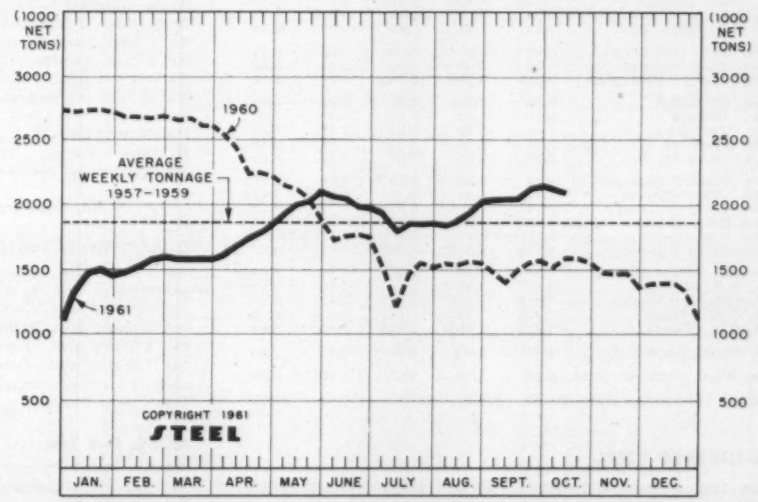
● **Cleveland**—With demand failing to rise to expected levels, producers have reduced operating schedules. After reaching the year's high of 137,041 tons for the week ended Sept. 30, output has eased to around the 132,000 ton level.

STEEL INGOT PRODUCTION

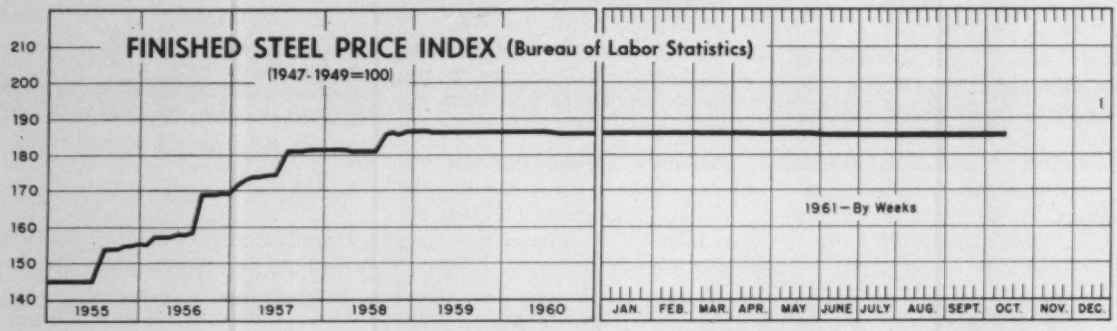
Weeks Ended	Net Tons	Change
Oct. 14	2,080,000*	— 1.0%
Oct. 7	2,102,000	— 1.4%
Sept. 30	2,131,000	+ 0.8%
Totals to Oct. 7		
1961	72,551,000	—10.8%
1960	81,323,000	

DISTRICTS	Week Ended Oct. 7 Tons‡	Week Ended Oct. 7 Index†	Week Ended Sept. 30 Index†
Northeastern	288,572	108	113
Buffalo	101,249	104	103
Pittsburgh	439,868	109	107
Youngstown	171,681	101	100
Cleveland	132,411	143	148
Detroit	129,048	123	147
Chicago	426,447	114	114
Cincinnati	93,502	124	129
St. Louis	62,535	119	114
Southern	114,900	106	108
Western	139,126	119	115
Industry	2,102,000	112.8	114.4

*Estimated by STEEL.
†1957-59 (1,862,933 tons) = 100.
‡District tonnages are approximate and will not necessarily add to the national total.



Price Indexes and Composites



Oct. 10, 1961	Week Ago	Month Ago	Sept. Index	Year Ago
185.4	185.4	185.4	185.4	186.2

AVERAGE PRICES OF STEEL (Bureau of Labor Statistics)

Week Ended Oct. 10

Prices include mill base prices and typical extras and deductions. Units are 100 lb except where otherwise noted in parentheses. For complete description of the following products and extras and deductions applicable to them, write to STEEL.

Rails, Standard No. 1	$5.825
Rails, Light, 40 lb	7.292
Tie Plates	6.875
Axles, Railway	10.175
Wheels, Freight Car, 33 in. (per wheel)	62.000
Plates, Carbon	6.350
Structural Shapes	6.167
Bars, Tool Steel, Carbon (lb)	0.560
Bars, Tool Steel, Alloy, Oil Hardening Die (lb)	0.680
Bars, Tool Steel, H.R. Alloy, High Speed, W 6.75, Cr 4.5, V 2.1, Mo 5.5, C 0.060 (lb)	1.400
Bars, Tool Steel, H.R. Alloy, High Speed, W18, Cr 4, V 1 (lb)	1.895
Bars, H.R., Alloy	10.775
Bars, H.R., Stainless, 303 (lb)	0.543
Bars, H.R., Carbon	6.675
Bars, Reinforcing	(N.A.)
Bars, C.F., Carbon	10.710
Bars, C.F., Alloy	14.125
Bars, C.F., Stainless, 302 (lb)	0.570
Sheets, H.R., Carbon	6.356
Sheets, C.R., Carbon	7.300
Sheets, Galvanized	8.775
Sheets, C.R., Stainless, 302 (lb)	0.643
Sheets, Electrical	12.625
Strip, C.R., Carbon	9.225
Strip, C.R., Stainless, 430 (lb)	0.460
Strip, H.R., Carbon	6.250
Pipe, Black, Buttweld (100 ft)	19.495
Pipe, Galv., Buttweld (100 ft)	23.098
Pipe Line (100 ft)	195.423
Casing, Oil Well, Carbon (100 ft)	193.028
Casing, Oil Well, Alloy (100 ft)	202.645
Tubes, Boiler (100 ft)	51.200
Tubing, Mechanical, Carbon (100 ft)	27.005
Tubing, Mechanical, Stainless, 304 (100 ft)	192.285
Tin Plate, Hot-dipped, 1.25 lb (95 lb base box)	10.100
Tin Plate, Electrolytic, 0.25 lb (95 lb base box)	8.300
Black Plate, Canmaking Quality (95 lb base box)	7.900
Wire, Drawn, Carbon	10.575
Wire, Drawn, Stainless, 430 (lb)	0.665
Bale Ties (Bundles)	7.647
Nails, 8d Common (50 lb)	4.715
Wire, Barbed (80-rod spool)	8.372
Woven Wire Fence (20-rod roll)	20.910

STEEL's FINISHED STEEL PRICE INDEX

	Oct. 11 1961	Week Ago	Month Ago	Year Ago	5 Yr Ago
Index (1935-39 avg = 100)	247.82	247.82	247.82	247.82	225.58
Index in cents per lb	6.713	6.713	6.713	6.713	6.111

STEEL's ARITHMETICAL PRICE COMPOSITES

Finished Steel, NT	$149.96	$149.96	$149.96	$149.96	$137.48
No. 2 Fdry, Pig Iron, GT	66.49	66.49	66.49	66.49	62.63
Basic Pig Iron, GT	65.99	65.99	65.99	65.99	62.18
Malleable Pig Iron, GT	67.27	67.27	67.27	67.27	63.41
Steelmaking Scrap, GT	39.17	39.50	39.83	30.17	57.00

Comparison of Prices

Comparative prices by districts in cents per pound except as otherwise noted. Delivered prices based on nearest production point.

FINISHED STEEL	Oct. 11 1961	Week Ago	Month Ago	Year Ago	5 Yr Ago
Bars, H.R., Pittsburgh	5.675	5.675	5.675	5.675	5.075
Bars, H.R., Chicago	5.675	5.675	5.675	5.675	5.075
Bars, H.R., deld., Philadelphia	5.98	5.98	5.98	5.975	4.93
Bars, C.R., Pittsburgh	7.65	7.65	7.65	7.65	6.85
Shapes, Std., Pittsburgh	5.50	5.50	5.50	5.50	5.00
Shapes, Std., Chicago	5.50	5.50	5.50	5.50	5.00
Shapes, deld., Philadelphia	5.745	5.745	5.745	5.77	5.00
Plates, Pittsburgh	5.30	5.30	5.30	5.30	4.85
Plates, Chicago	5.30	5.30	5.30	5.30	4.85
Plates, Coatesville, Pa.	5.30	5.30	5.30	5.30	5.25
Plates, Sparrows Point, Md.	5.30	5.30	5.30	5.30	4.85
Plates, Claymont, Del.	5.30	5.30	5.30	5.30	5.35
Sheets, H.R., Pittsburgh	5.10	5.10	5.10	5.10	4.675
Sheets, H.R., Chicago	5.10	5.10	5.10	5.10	4.675
Sheets, C.R., Pittsburgh	6.275	6.275	6.275	6.275	5.75
Sheets, C.R., Chicago	6.275	6.275	6.275	6.275	5.75
Sheets, C.R., Detroit	6.275	6.275	6.275	6.275	5.75-5.85
Sheets, Galv., Pittsburgh	6.875	6.875	6.875	6.875	6.30
Strip, H.R., Pittsburgh	5.10	5.10	5.10	5.10	4.675
Strip, H.R., Chicago	5.10	5.10	5.10	5.10	4.675
Strip, C.R., Pittsburgh	7.425	7.425	7.425	7.425	6.85
Strip, C.R., Chicago	7.425	7.425	7.425	7.425	6.85
Strip, C.R., Detroit	7.425	7.425	7.425	7.425	6.95
Wire, Basic, Pittsburgh	8.00	8.00	8.00	8.00	7.20
Nails, Wire, nonstock, Pitts.	8.95	8.95	8.95	8.95	8.20
Tin Plate (1.50 lb) box, Pitts.	$10.65	$10.65	$10.65	$10.65	$9.85

SEMIFINISHED STEEL					
Billets, forging, Pitts. (NT)	$99.50	$99.50	$99.50	$99.50	$91.50
Wire rods, $\frac{7}{32}$-⅜" Pitts.	6.40	6.40	6.40	6.40	5.80

PIG IRON, Gross Ton	Oct. 11 1961	Week Ago	Month Ago	Year Ago	5 Yr Ago
Bessemer, Pittsburgh	$67.00	$67.00	$67.00	$67.00	$63.50
Basic, Valley	66.00	66.00	66.00	66.00	62.50
Basic, deld., Philadelphia	70.18	70.18	70.18	70.07	66.26
No. 2 Fdry, Neville Island, Pa.	66.50	66.50	66.50	66.50	63.00
No. 2 Fdry, Chicago	66.50	66.50	66.50	66.50	63.00
No. 2 Fdry, deld., Phila.	70.68	70.68	70.68	70.57	66.76
No. 2 Fdry, Birmingham	62.50	62.50	62.50	62.50	59.00
No. 2 Fdry (Birm.), deld., Cin.	70.20	70.20	70.20	70.20	66.70
Malleable, Valley	66.50	66.50	66.50	66.50	63.00
Malleable, Chicago	66.50	66.50	66.50	66.50	63.00
Ferromanganese, net ton†	245.00	245.00	245.00	245.00	215.00

†74-76% Mn, Duquesne, Pa.

SCRAP, Gross Ton (Including broker's commission)					
No. 1 Heavy Melt, Pittsburgh	$37.50	$37.50	$37.50	$28.50	$56.50
No. 1 Heavy Melt, E. Pa.	40.50	40.50	40.50	34.00	56.50
No. 1 Heavy Melt, Chicago	39.50	40.50	41.50	28.00	58.00
No. 1 Heavy Melt, Valley	39.50	42.50	42.50	28.50	64.50
No. 1 Heavy Melt, Cleve.	36.50	38.50	38.50	26.50	63.00
No. 1 Heavy Melt, Buffalo	32.50	32.50	31.50	27.50	57.50
Rails, Rerolling, Chicago	60.50	61.50	61.50	49.50	83.00
No. 1 Cast, Chicago	42.50	44.50	43.50	36.50	50.50

COKE, Net Ton					
Beehive, Furn., Connisvl.	$15.00	$15.00	$15.00	$15.00	$14.50
Beehive, Fdry., Connisvl.	18.25	18.25	18.25	18.25	17.50
Oven, Fdry., Milwaukee	32.00	32.00	32.00	32.00	29.50

Steel Prices

Mill base prices reported to STEEL, Oct. 1, cents per pound except as otherwise noted. *Changes shown in italics.* Code number following mill point indicates producing company. Key to producers, page 203; footnotes, page 205.

SEMIFINISHED

INGOTS, Carbon Forging (NT)

Munhall,Pa. U5 ....$76.00

INGOT, Alloy (NT)

Detroit S41 .....$82.00
Economy,Pa. B14 ....82.00
Farrell,Pa.. S3 .....82.00
Lowellville,O. S3 ....82.00
Midland,Pa. C18 .....82.00
Munhall,Pa. U5 .....82.00
Sharon,Pa. S3 .....82.00

BILLETS, BLOOMS & SLABS
Carbon Rolling (NT)

Bartonville,Ill. K4 ....$82.00
Bessemer,Pa. U5 .....80.00
Buffalo R2 .....80.00
Clairton,Pa. U5 .....80.00
Ensley,Ala. T2 .....80.00
Fairfield,Ala. T2 .....80.00
Fontana,Calif. K1 ....90.50
Gary,Ind. U5 .....80.00
Johnstown,Pa. B2 ....80.00
Lackawanna,N.Y. B2..80.00
Munhall,Pa. U5 .....80.00
Owensboro,Ky. G8 ....80.00
S.Chicago,Ill. R2, U5..80.00
S.Duquesne,Pa. U5 ....80.00
Sterling,Ill. N15 .....80.00
Youngstown R2 .....80.00

Carbon, Forging (NT)

Bessemer,Pa. U5 ....$99.50
Buffalo R2 .....99.50
Canton,O. R2 .....102.00
Clairton,Pa. U5 .....99.50
Conshohocken,Pa. A3 ..99.50
Ensley,Ala. T2 .....99.50
Fairfield,Ala. T2 .....99.50
Farrell,Pa. S3 .....99.50
Fontana,Calif. K1 ....109.00
Gary,Ind. U5 .....99.50
Geneva,Utah C11 .....99.50
Houston S5 .....104.50
Johnstown,Pa. B2 ....99.50
Lackawanna,N.Y. B2 ..99.50
LosAngeles B3 .....109.00
Midland,Pa. C18 .....99.50
Munhall,Pa. U5 .....99.50
Owensboro,Ky. C8 ....99.50
Seattle B3 .....109.00
Sharon,Pa. S3 .....99.50
S.Chicago R2, U5, W14..99.50
S.Duquesne,Pa. U5 ....99.50
S.SanFrancisco B3 ..109.00
Warren,O. C17 .....99.50

Alloy, Forging (NT)

Bethlehem,Pa. B2 ...$119.00
Bridgeport,Conn. C32..119.00
Buffalo R2 .....119.00
Canton,O. R2,T7 ....119.00
Conshohocken,Pa. A3 .121.00
Detroit S41 .....119.00
Economy,Pa. B14 ....119.00
Farrell,Pa. S3 .....119.00
Fontana,Calif. K1 ....140.00
Gary,Ind. U5 .....119.00
Houston S5 .....124.00
Ind.Harbor,Ind. Y1 ..119.00
Johnstown,Pa. B2 ....119.00
Lackawanna,N.Y. B2 .119.00
LosAngeles B3 .....139.00
Lowellville,O. S3 ....119.00
Massillon,O. R2 .....119.00
Midland,Pa. C18 .....119.00
Munhall,Pa. U5 .....119.00
Owensboro,Ky. G8 ....119.00
Seattle(6) B3 .....140.00
Sharon,Pa. S3 .....119.00
S.Chicago R2,U5,W14..119.00
S.Duquesne,Pa. U5 ....119.00
Struthers,O. Y1 .....119.00
Warren,O. C17 .....119.00

ROUNDS, SEAMLESS TUBE (NT)

Buffalo R2 .....$122.50
Canton,O. R2 .....125.00
Cleveland R2 .....122.50
Gary,Ind. U5 .....122.50
S.Chicago,Ill. R2,W14 122.50
S.Duquesne,Pa. U5 ....122.50
Warren,O. C17 .....122.50

SKELP

Aliquippa,Pa. J5 .....5.05
Benwood,W.Va. W10 ...5.05
Ind.Harbor,Ind. Y1 ....5.05
Munhall,Pa. P5 .....5.05
Pittsburgh J5 .....5.05
Warren,O. R2 .....5.05
Youngstown R2, U5 ....5.05

WIRE RODS

AlabamaCity,Ala. R2 ...6.40
Aliquippa,Pa. J5 .....6.40
Alton,Ill. L1 .....6.60
Bartonville,Ill. K4 ....6.50
Buffalo W12 .....6.40
Cleveland A7 .....6.40
Donora,Pa. A7 .....6.40
Fairfield,Ala. T2 .....6.40
Houston S5 .....6.65
IndianaHarbor,Ind. Y1 ..6.40
Johnstown,Pa. B2 .....6.40
Joliet,Ill. A7 .....6.40
KansasCity,Mo. S5 ....6.65
Kokomo,Ind. C16 .....6.50
LosAngeles B3 .....7.20
Minnequa,Colo. C10 ....6.65
Monessen,Pa. P7 .....6.40
N.Tonawanda S47 .....6.40
Pittsburg,Calif. C11 ....7.20
Portsmouth,O. P12 .....6.40
Roebling,N.J. R5 .....6.50
S.Chicago,Ill. R2, W14..6.40
SparrowsPoint,Md. B2..6.50
Sterling,Ill.(1) N15 ....6.40
Sterling,Ill. N15 .....6.50
Struthers,O. Y1 .....6.40
Worcester,Mass. A7 ....6.70

STRUCTURALS

Carbon Steel Std. Shapes

AlabamaCity,Ala. R2 ...5.50
Aliquippa,Pa. J5 .....5.50
Atlanta A11 .....5.70
Bessemer,Ala. T2 .....5.50
Bethlehem,Pa. B2 .....5.55
Birmingham C15 .....5.50
Clairton,Pa. U5 .....5.50
Fairfield,Ala. T2 .....5.50
Fontana,Calif. K1 .....6.30
Gary,Ind. U5 .....5.50
Geneva,Utah C11 .....5.50
Houston S5 .....5.60
Ind.Harbor,Ind. I-2, Y1 5.50
Johnstown,Pa. B2 .....5.55
Joliet,Ill. P22 .....5.50
KansasCity,Mo. S5 .....5.60
Lackawanna,N.Y. B2 ....5.55
LosAngeles B3 .....6.20
Minnequa,Colo. C10 ....5.80
Munhall,Pa. U5 .....5.50
Niles,Calif. P1 .....6.25
Phoenixville,Pa. P4 ....5.55
Portland,Oreg. O4 .....6.25
Seattle B3 .....6.25
S.Chicago,Ill. U5, W14..5.50
S.SanFrancisco B3 ....6.15
Sterling,Ill. N15 .....5.50
Struthers,O. Y1 .....5.50
Torrance,Calif. C11 ....6.20
Weirton,W.Va. W6 .....5.50

Wide Flange

Bethlehem,Pa. B2 .....5.55
Clairton,Pa. U5 .....5.50
Fontana,Calif. K1 .....6.45
IndianaHarbor,Ind. I-2 .5.50
Lackawanna,N.Y. B2 ....5.55
Munhall,Pa. U5 .....5.50
Phoenixville,Pa. P4 ....5.55
S.Chicago,Ill. U5 .....5.50
Sterling,Ill. N5 .....5.50
Weirton,W.Va. W6 .....5.50

Alloy Std. Shapes

Aliquippa,Pa. J5 .....6.80
Clairton,Pa. U5 .....6.80
Gary,Ind. U5 .....6.80
Houston S5 .....6.90
Munhall,Pa. U5 .....6.80
S.Chicago,Ill. U5, W14 .6.80

H.S., L.A., Std. Shapes

Aliquippa,Pa. J5 .....8.05
Bessemer,Ala. T2 .....8.05
Bethlehem,Pa. B2 .....8.10
Clairton,Pa. U5 .....8.05
Fairfield,Ala. T2 .....8.05
Fontana,Calif. K1 .....8.85
Gary,Ind. U5 .....8.05
Geneva,Utah C11 .....8.05
Houston S5 .....8.15
Ind.Harbor,Ind. I-2, Y1 8.05
Johnstown,Pa. B2 .....8.10
KansasCity,Mo. S5 .....8.15
LackawannaN.Y. B2 ....8.10
LosAngeles B3 .....8.75
Munhall,Pa. U5 .....8.05
Phoenixville,Pa. P4 ....8.10
Seattle B3 .....8.80
S.Chicago,Ill. U5, W14..8.05
S.SanFrancisco B3 ....8.70
Sterling,Ill. N15 .....7.75
Struthers,O. Y1 .....8.05

H.S., L.A., Wide Flange

Bethlehem,Pa. B2 .....8.10
Ind.Harbor,Ind. I-2 ....8.05
Lackawanna,N.Y. B2 ....8.10
Munhall,Pa. U5 .....8.05
S.Chicago,Ill. U5 .....8.05
Sterling,Ill. N15 .....7.75

PILING

BEARING PILES

Bethlehem,Pa. B2 .....5.55
Ind.Harbor,Ind. I-2 ....5.50
Lackawanna,N.Y. B2 ....5.55
Munhall,Pa. U5 .....5.50
S.Chicago,Ill. I-2, U5 ...5.50

STEEL SHEET PILING

Ind.Harbor,Ind. I-2 ....6.50
Lackawanna,N.Y. B2 ...6.50
Munhall,Pa. U5 .....6.50
S.Chicago,Ill. I-2, U5 ...6.50
Weirton,W.Va. W6 ....6.50

PLATES

PLATES, Carbon Steel

AlabamaCity,Ala. R2 ...5.30
Aliquippa,Pa. J5 .....5.30
Ashland,Ky(15) A10 ...5.30
Bessemer,Ala. T2 .....5.30
Clairton,Pa. U5 .....5.30
Claymont,Del. P4 .....5.30
Cleveland J5, R2 .....5.30
Coatesville,Pa. L7 .....5.30
Conshohocken,Pa. A3 ...5.30
Ecorce,Mich. G5 .....5.30
Fairfield,Ala. T2 .....5.30
Farrell,Pa. S3 .....5.30
Fontana,Calif.(30) K1 ..6.10
Gary,Ind. U5 .....5.30
Geneva,Utah C11 .....5.30
GraniteCity,Ill. G4 ....5.40
Houston S5 .....5.40
Ind.Harbor,Ind. I-2, Y1.5.30
Johnstown,Pa. B2 .....5.30
Lackawanna,N.Y. B2 ...5.30
Mansfield,O. E6 .....5.30
Minnequa,Colo. C10 ....6.15
Munhall,Pa. U5 .....5.30
Newport,Ky. A2 .....5.30
Pittsburgh J5 .....5.30
Riverdale,Ill. A1 .....5.30
Seattle B2 .....6.20
Sharon,Pa. S3 .....5.30
S.Chicago,Ill. U5, W14..5.30
SparrowsPoint,Md. B2 ..5.30
Sterling,Ill. N15 .....5.30
Steubenville,O. W10 ....5.30
Warren,O. R2 .....5.30
Youngstown U5, Y1 ....5.30
Youngstown(27) R2 ....5.30

PLATES, Carbon Abras. Resist.

Claymont,Del. P4 .....7.05
Fontana,Calif. K1 .....7.85
Geneva,Utah C11 .....7.05
Houston S5 .....7.15
Johnstown,Pa. B2 ....7.05
SparrowsPoint,Md. B2 ..7.05

PLATES, Wrought Iron

Economy,Pa. B14 ....14.10

PLATES, H.S., L.A.

Aliquippa,Pa. J5 .....7.95
Ashland,Ky. A10 .....7.95
Bessemer,Ala. T2 .....7.95
Clairton,Pa. U5 .....7.95
Claymont,Del. P4 .....7.95
Cleveland J5, R2 .....7.95
Coatesville,Pa. L7 .....7.95
Conshohocken,Pa. A3 ...7.95
Economy,Pa. B14 .....7.95
Ecorse,Mich. G5 .....7.95
Fairfield,Ala. T2 .....7.95
Farrell,Pa. S3 .....7.95
Fontana,Calif.(30) K1 ..8.75
Gary,Ind. U5 .....7.95
Geneva,Utah C11 .....7.95
Houston S5 .....8.05
Ind.Harbor,Ind. I-2, Y1 .7.95
Johnstown,Pa. B2 .....7.95
Munhall,Pa. U5 .....7.95
Pittsburgh J5 .....7.95
Seattle B3 .....8.85
Sharon,Pa. S3 .....7.95
S.Chicago,Ill. U5, W14..7.95
SparrowsPoint,Md. B2..7.95
Sterling,Ill. N15 .....7.625
Warren,O. R2 .....7.95
Youngstown U5, Y1 ....7.95

PLATES, Alloy

Claymont,Del. P4 .....7.50
Coatesville,Pa. L7 .....7.50
Economy,Pa. B14 .....7.50
Farrell,Pa. S3 .....7.50
Fontana,Calif. K1 ....8.30
Gary,Ind. U5 .....7.50
Houston S5 .....7.60
Ind.Harbor,Ind. Y1 ....7.50
Johnstown,Pa. B2 .....7.50
Lowellville,O. S3 .....7.50
Munhall,Pa. U5 .....7.50
Newport,Ky. A2 .....7.50
Pittsburgh J5 .....7.50
Seattle B3 .....8.40
Sharon,Pa. S3 .....7.50
S.Chicago,Ill. U5, W14..7.50
SparrowsPoint,Md. B2 ..7.50
Youngstown Y1 .....7.50

PLATES, Ingot Iron

Ashland c.l. (15) A10 ..5.55
Ashland l.c.l.(15) A10 ..6.05
Cleveland c.l. R22 .....6.05
Warren,O. R2 .....6.05

FLOOR PLATES

Cleveland J5 .....6.375
Claymont,Del. P4 .....6.375
Conshohocken,Pa. A3 ...6.375
Ind.Harbor,Ind. I-2 ...6.375
Munhall,Pa. U5 .....6.375
Pittsburgh J5 .....6.375
S.Chicago,Ill. U5 .....6.375

BARS

BARS, Hot-Rolled Carbon
(Merchant Quality)

Ala.City,Ala(9) R2 ...5.675
Aliquippa,Pa.(9) J5 ...5.675
Alton,Ill. L1 .....5.875
Atlanta(9) A11 .....5.875
Bessemer,Ala.(9) T2 ..5.675
Birmingham(9) C15....5.675
Buffalo(9) R2 .....5.675
Canton,O.(23) R2 .....6.15
Clairton,Pa.(9) U5 ....5.675
Cleveland(9) R2 .....5.675
Ecorse,Mich.(9) G5 ....5.675
Emeryville,Calif. J7 ...6.425
Fairfield,Ala.(9) T2 ...5.675
Fairless,Pa.(9) U5 ....5.825
Fontana,Calif.(9) K1...6.375
Gary,Ind.(9) U5 .....5.675
Houston(9) S5 .....5.925
Ind.Harbor(9) I-2, Y1..5.675
Johnstown,Pa.(9) B2 ..5.675
Joliet,Ill. P2 .....5.675
KansasCity,Mo.(9) S5..5.925
Lackawanna(9) B2 ....5.675
LosAngeles(9) B3 ....6.375
Massillon,O.(23) R2 ....6.15
Midland,Pa.(23) C18 ...6.025
Milton,Pa. M18 .....5.825
Minnequa,Colo. C10 ....6.125
Niles,Calif. P1 .....6.375
N.Tonawanda S47 .....5.675
Owensboro,Ky.(9) G8...6.025
Pittsburg,Calif.(9) C11.6.375
Pittsburgh(9) J5 .....5.675
Portland,Oreg. O4 .....6.425
Riverdale,Ill.(9) A1 ...5.675
Seattle(9) A24,B3,N15..6.425
S.Ch'e'go(9)R2,U5,W14 5.675
S.Duquesne,Pa.(9) U5..5.675
S.SanFran.,Calif.(9)B3 6.425
Sterling,Ill.(1)(9) N15..5.675
Sterling,Ill.(9) N15 ....5.775
Struthers,O.(9) Y1 .....5.675
Tonawanda,N.Y. B12 ...5.675
Torrance,Calif.(9) C11..6.375
Warren,O. C17 .....6.025
Youngstown(9) R2, U5..5.675

BARS, Hot-Rolled Alloy

Aliquippa,Pa. J5 .....6.725
Bethlehem,Pa. B2 .....6.725
Bridgeport,Conn. C32 ...6.80
Buffalo R2 .....6.725
Canton,O. R2, T7 .....6.725
Clairton,Pa. U5 .....6.725
Detroit S41 .....6.725
Economy,Pa. B14 .....6.725
Ecorse,Mich. G5 .....6.725
Farrell,Pa. S3 .....6.725
Fontana,Calif. K1 .....7.775
Gary,Ind. U5 .....6.725
Houston S5 .....6.975
Ind.Harbor,Ind. I-2, Y1 6.725
Johnstown,Pa. B2 .....6.725
KansasCity,Mo. S5 .....6.975
Lackawanna,N.Y. B2 ...6.725
LosAngeles B3 .....7.775
Lowellville,O. S3 .....6.725
Massillon,O. R2 .....6.725
Midland,Pa. C18 .....6.725
N. Tonawanda S47 .....6.725
Owensboro,Ky. G8 .....6.725
Pittsburgh J5 .....6.725
Seattle(6) B3 .....7.825
Sharon,Pa. S3 .....6.725
S.Chicago R2, U5, W14 6.725
S.Duquesne,Pa. U5 ....6.725
Struthers,O. Y1 .....6.725
Warren,O. C17 .....6.725
Youngstown U5 .....6.725

BARS & SMALL SHAPES, H.R.
High-Strength, Low-Alloy

Aliquippa,Pa. J5 .....8.30
Bessemer,Ala. T2 .....8.30
Bethlehem,Pa. B2 .....8.30
Clairton,Pa. U5 .....8.30
Cleveland R2 .....8.30
Ecorse,Mich. G5 .....8.30
Fairfield,Ala. T2 .....8.30
Fontana,Calif. K1 .....9.00
Gary,Ind. U5 .....8.30
Houston S5 .....8.55
Ind.Harbor,Ind. Y1 ....8.30
Johnstown,Pa. B2 .....8.30
KansasCity,Mo. S5 .....8.55
Lackawanna,N.Y. B2 ...8.30
LosAngeles B3 .....9.00
Pittsburgh J5 .....8.30
Seattle B3 .....9.05
S.Chicago,Ill. R2, W14..8.30
S.Duquesne,Pa. U5 ....8.30
S.SanFrancisco B3 ....9.05
Sterling,Ill. N15 .....7.925
Struthers,O. Y1 .....8.30
Youngstown U5 .....8.30

BAR SIZE ANGLES; H.R. Carbon

Bethlehem,Pa.(9) B2 ..5.825
Houston(9) S5 .....5.925
KansasCity,Mo.(9) S5..5.925
Lackawanna(9) B2 ....5.675
Sterling,Ill. N15 .....5.775
Sterling,Ill.(1) N15 ....5.675
Tonawanda,N.Y. B12 ..5.675

BAR SIZE ANGLES; S. SHAPES

Aliquippa,Pa. J5 .....5.675
Atlanta A11 .....5.875
Joliet,Ill. P22 .....5.675
Minnequa,Colo. C10 ...6.125
Niles,Calif. P1 .....6.375
Pittsburgh J5 .....5.675
Portland,Oreg. O4 .....6.425
SanFrancisco S7 .....6.52
Seattle B3 .....6.425

BAR SIZE ANGLES; S. SHAPES
Wrought Iron

Economy,Pa. B14 .....16.45

BAR SHAPES, Hot-Rolled Alloy

Aliquippa,Pa. J5 .....6.80
Clairton,Pa. U5 .....6.80
Gary,Ind. U5 .....6.80
Houston S5 .....7.05
KansasCity,Mo. S5 .....7.05
Pittsburgh J5 .....6.80
Youngstown U5 .....6.80

BARS, C.F. Loaded
(Including loaded extra)
Carbon

LosAngeles P2, S30 ..11.75*

Alloy

Ambridge,Pa. W18 ....10.175
BeaverFalls,Pa. M12..10.175
Camden,N.J. P13 .....10.35
Chicago W18 .....10.175
Elyria,O. W8 .....10.175
Monaca,Pa. S17 .....10.175
Newark,N.J. W18 .....10.35
SpringCity,Pa. K3 .....10.35

*Grade A; add 0.5e for Grade B.

BARS, Cold-Finished Carbon

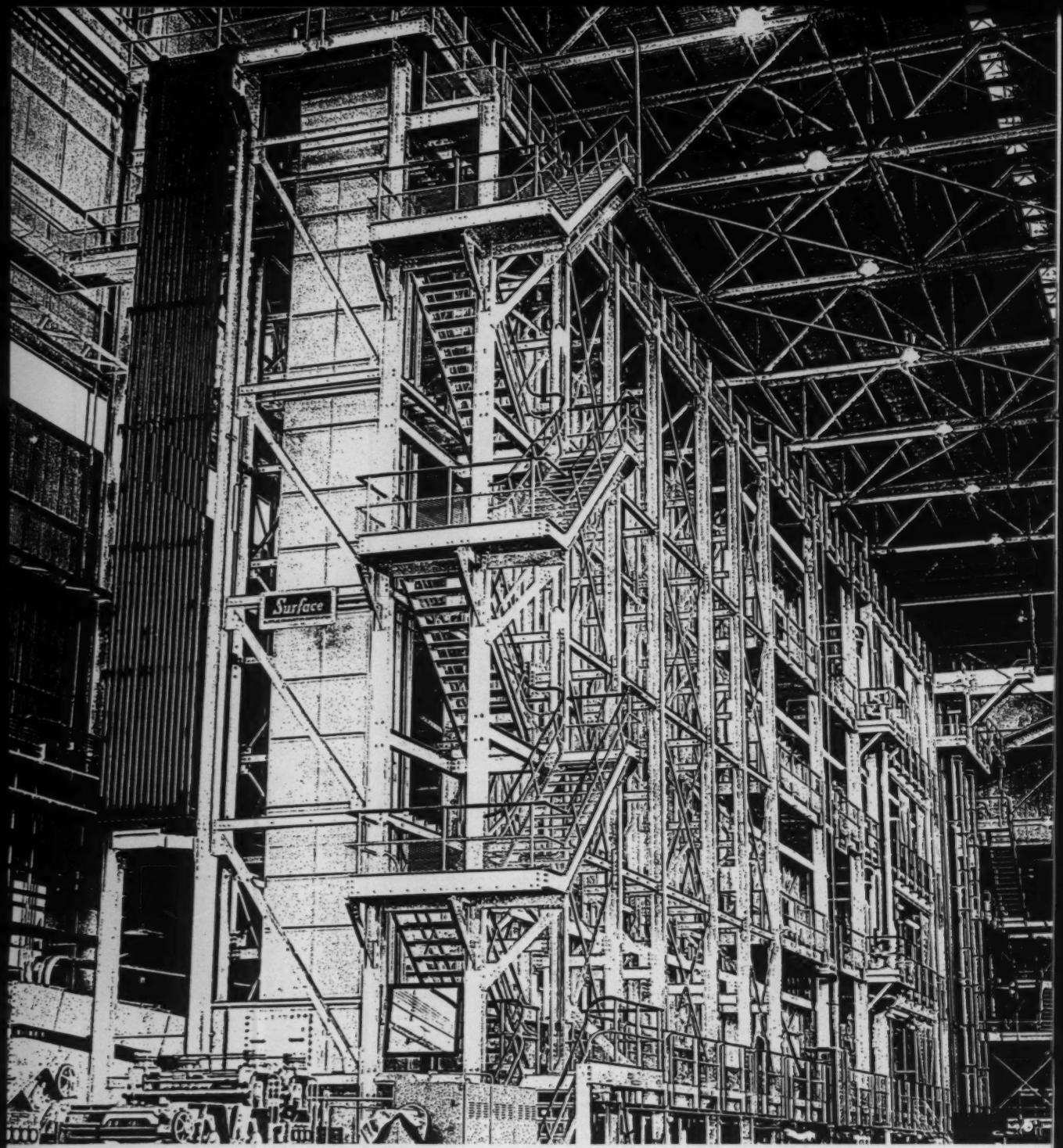
Ambridge,Pa. W18 .....7.65
BeaverFalls,Pa. M12,R2 7.65
Birmingham C15 .....8.10
Buffalo B5 .....7.70
Camden,N.J. P13 .....8.10
Carnegie,Pa. C12 .....7.65
Chicago W18 .....7.65
Cleveland A7, C20 .....7.65
Detroit B5, H5, P17 ....7.85
Detroit S41 .....7.65
Donora,Pa. A7 .....7.65
Elyria,O. W8 .....7.65
FranklinPark,Ill. N5 ...7.65
Gary,Ind. R2 .....7.65
GreenBay,Wis. F7 .....7.65
Hammond,Ind. J5, L2 ...7.65
Hartford,Conn. R2 .....8.15
Harvey,Ill. B5 .....7.65
LosAngeles(49) S30 ....9.10
LosAngeles(49) P2, R2..9.10
Mansfield,Mass. B5 ....8.20
Massillon,O. R2, R8 ....7.65
Midland,Pa. C18 .....7.65
Monaca,Pa. S17 .....7.65
Newark,N.J. W18 .....8.10
NewCastle,Pa.(17) B4 ..7.65
Pittsburgh J5 .....7.65
Plymouth,Mich. P5 ....7.90
Putnam,Conn. W18 ....8.20
Readville,Mass. C14 ....8.20
Seattle(49) S30 .....9.10
S.Chicago,Ill. W14 .....7.65
SpringCity,Pa. K3 .....8.10
Struthers,O. Y1 .....7.65
Warren,O. C17 .....7.65
Waukegan,Ill. A7 .....7.65
Willimantic,Conn. J5 ...8.15
Youngstown F3, Y1 ....7.65

BARS, Cold-Finished Alloy
(Turned and Ground)

Cumberland,Md.(5) C19 6.85

BARS, Cold-Finished Alloy

Ambridge,Pa. W18 ....9.025
BeaverFalls,Pa. M12,R2 9.025
Bethlehem,Pa. B2 .....9.025
Bridgeport,Conn. C32 ..9.175
Buffalo B5 .....9.025
Camden,N.J. P13 .....9.20
Canton,O. T7 .....9.025
Carnegie,Pa. C12 .....9.025
Chicago W18 .....9.025
Cleveland A7, C20 .....9.025
Detroit B5, P17 .....9.225
Detroit H5, S41 .....9.025
Donora,Pa. A7 .....9.025
Elyria,O. W8 .....9.025
FranklinPark,Ill. N5 ..9.025
Gary,Ind. R2 .....9.025
GreenBay,Wis. F7 .....9.025



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SURFACE

SURFACE COMBUSTION, Toledo 1, Ohio/ a division of Midland-Ross Corporation

Hammond,Ind. J5, L2..9.025
Hartford,Conn. R2 ....9.325
Harvey,Ill. R5 ....9.025
Lackawanna,N.Y. B3 ..9.025
LosAngeles P2, S30 ...11.00
Mansfield,Mass. B5 ...9.325
Massillon,O. R2, R8 ...9.025
Midland,Pa. C18 .....9.025
Monaca,Pa. S17 .....9.025
Newark,N.J. W18 .....9.20
N.Tonawanda S47 .....9.025
Plymouth,Mich. P5 ....9.225
S.Chicago,Ill. W14 ....9.025
SpringCity,Pa. K3 .....9.20
Struthers,O. Y1 .....9.025
Warren,O. C17 .....9.025
Waukegan,Ill. A7 .....9.025
Willimantic,Conn. J5 ..9.325
Worcester,Mass. A7 ...9.325
Youngstown F3, Y1 ...9.025

BARS, Reinforcing, Billet (To Fabricators)

Atlanta A11 .....5.00
Birmingham C15 .....5.25
Ecorse,Mich. G5 .....5.675
Emeryville,Calif. J7 ...6.425
Fontana,Calif. K1 ....6.375
Ind.Harbor,Ind. Y1 ....5.675
Johnstown,Pa. B2 ....5.675
Joliet,Ill. P22 .....5.675
Kokomo,Ind. C16 .....5.775
Lackawanna,N.Y. B2 ..5.675
LosAngeles B3 .....6.375
Madison,Ill. L1 .....5.475
Milton,Pa. M18 .....5.825
Minnequa,Colo. C10 ...6.125
Niles,Calif. P1 .....6.375
Pittsburgh J5 .....5.675
Portland,Oreg. O4 ....6.425
Seattle A24, B3, N14 ..6.425
S.Chicago,Ill. W14 ....5.675
S.SanFrancisco B3 ....6.425
SparrowsPoint,Md. B2..5.675
Steelton,Pa. B2 .....5.675
Sterling,Ill. (1) N15 ..5.675
Sterling,Ill. N15 .....5.775
Struthers,O. Y1 .....5.675
Tonawanda,N.Y. B12 ..6.10

BARS, Reinforcing, Billet (Fabricated, to Consumers)

Baltimore B2 .....7.42
Boston B2, U8 .....8.15
Chicago U8 .....7.41
Cleveland U8 .....7.39
Johnstown,Pa. B2 .....7.33
Lackawanna,N.Y. B2 ..7.35
Marion,O. P11 .....6.70
Newark,N.J. U8 .....7.80
Philadelphia U8 .....7.63
Pittsburgh J5, U8 .....7.35
Seattle A24, B3, N14 ...7.95
SparrowsPoint,Md. B2 ..7.33
St.Paul U8 .....8.17

BARS, Wrought Iron

Economy,Pa.(S.R.)B14 16.10
Economy,Pa.(D.R.)B14 20.50
Econ.(DirectRolled)B14 13.55
Economy(Staybolt)B14 20.50
McK.Rks.(S.R.) L5 ...16.10
McK.Rks(D.R.) L5 ...20.50
McK.Rks.(Dir.Rolled)L513.55

BARS, Rail Steel

ChicagoHts.(3) C2, I-2 5.575
ChicagoHts.(4)(44) I-2 5.675
ChicagoHts.(4) C2 ....5.675
Franklin,Pa.(3) F5 ...5.575
Franklin,Pa.(4) F5 ...5.675
JerseyShore,Pa.(3) J8 ..5.55
Marion,O.(3) P11 ....5.575
Tonawanda(3) B12 ....5.575
Tonawanda(4) B12 ....6.10

SHEETS

SHEETS, Hot-Rolled Steel (18 Gage and Heavier)

AlabamaCity,Ala. R2 ...5.10
Allenport,Pa. P7 .....5.10
Aliquippa,Pa. J5 .....5.10
Ashland,Ky.(8) A10 ....5.10
Cleveland J5, R2 .....5.10
Conshohocken,Pa. A3 ...5.15
Detroit(8) M1 .....5.10
Ecorse,Mich. G5 .....5.10
Fairfield,Ala. T2 .....5.10
Fairless,Pa. U5 .....5.15
Farrell,Pa. S3 .....5.10
Fontana,Calif. K1 ....5.825
Gary,Ind. U5 .....5.10
Geneva,Utah C11 .....5.20
GraniteCity,Ill.(8) G4 ..5.20
Ind.Harbor,Ind. I-2, Y1 5.10
Irvin,Pa. U5 .....5.10
Lackawanna,N.Y. B2 ..5.10
Mansfield,O. E6 .....5.10
Munhall,Pa. U5 .....5.10
Newport,Ky. A2 .....5.10
Niles,O. M21, S3 .....5.10
Pittsburg,Calif. C11 ....5.80
Pittsburgh J5 .....5.10
Portsmouth,O. P12 ....5.10
Riverdale,Ill. A1 .....5.10
Sharon,Pa. S3 .....5.10
S.Chicago,Ill. U5, W14..5.10
SparowsPoint,Md. B2 ..5.10
Steubenville,O. W10 ....5.10
Warren,O. R2 .....5.10
Weirton,W.Va. W6 ....5.10
Youngstown U5, Y1 ...5.10

SHEETS, H.R. (19 Ga. & Lighter)

Niles,O. M21, S3 .....6.275

SHEETS, H.R. Alloy

Gary,Ind. U5 .....8.40
Ind.Harbor,Ind. Y1 .....8.40
Irvin,Pa. U5 .....8.40
Munhall,Pa. U5 .....8.40
Newport,Ky. A2 .....8.40
Youngstown U5, Y1 ....8.40

SHEETS, H.R. (14 Ga. & Heavier) High-Strength, Low-Alloy

Aliquippa,Pa. J5 .....7.525
Ashland,Ky. A10 .....7.525
Cleveland J5, R2 .....7.525
Conshohocken,Pa. A3 ..7.575
Ecorse,Mich. G5 .....7.525
Fairfield,Ala. T2 .....7.525
Fairless,Pa. U5 .....7.575
Farrell,Pa. S3 .....7.525
Fontana,Calif. K1 .....8.25
Gary,Ind. U5 .....7.525
Ind.Harbor,Ind. I-2, Y1 7.525
Irvin,Pa. U5 .....7.525
Lackawanna(35) B2 ...7.525
Munhall,Pa. U5 .....7.525
Niles,O. S3 .....7.525
Pittsburgh J5 .....7.525
S.Chicago,Ill. U5, W14 7.525
Sharon,Pa. S3 .....7.525
SparrowsPoint(36) B2..7.525
Warren,O. R2 .....7.525
Weirton,W.Va. W6 ....7.525
Youngstown U5, Y1 ...7.525

SHEETS, Hot-Rolled Ingot Iron (18 Gage and Heavier)

Ashland,Ky.(8) A10 ....5.35
Cleveland R2 .....5.875
Warren,O. R2 .....5.875

SHEETS, Cold-Rolled Ingot Iron

Cleveland R2 .....7.05
Middletown,O. A10 ....6.775
Warren,O. R2 .....7.05

SHEETS, Cold-Rolled Steel (Commercial Quality)

AlabamaCity,Ala. R2 ..6.275
Aliquippa,Pa. J5 .....6.275
Allenport,Pa. P7 .....6.275
Cleveland J5, R2 .....6.275
Conshohocken,Pa. A3 ..6.325
Detroit M1 .....6.275
Ecorse,Mich. G5 .....6.275
Fairfield,Ala. T2 .....6.275
Fairless,Pa. U5 .....6.325
Follansbee,W.Va. F4 ..6.275
Fontana,Calif. K1 .....7.40
Gary,Ind. U5 .....6.275
GraniteCity,Ill. G4 ....6.375
Ind.Harbor,Ind. I-2, Y1 6.275
Irvin,Pa. U5 .....6.275
Lackawanna,N.Y. B2 ..6.275
Mansfield,O. E6 .....6.275
Middletown,O. A10 ....6.275
Newport,Ky. A2 .....6.275
Pittsburg,Calif. C11 ...7.225
Pittsburgh J5 .....6.275
Portsmouth,O. P12 ....6.275
SparrowsPoint,Md. B2..6.275
Steubenville,O. W10 ....6.275
Warren,O. R2 .....6.275
Weirton,W.Va. W6 ....6.275
Yorkville,O. W10 .....6.275
Youngstown Y1 .....6.275

SHEETS, Cold-Rolled, High-Strength, Low-Alloy

Aliquippa,Pa. J5 .....9.275
Cleveland J5, R2 .....9.275
Ecorse,Mich. G5 .....9.275
Fairless,Pa. U5 .....9.325
Fontana,Calif. K1 .....10.40
Gary,Ind. U5 .....9.275
Ind.Harbor,Ind. I-2, Y1 9.275
Lackawanna(38) B2 ..9.275
Pittsburgh J5 .....9.275
SparrowsPoint(33) B2..9.275
Warren,O. R2 .....9.275
Weirton,W.Va. W6 ....9.275
Youngstown Y1 .....9.275

SHEETS, Culvert	Cu Steel	Cu Fe
Ala.City,Ala. R2	7.125	....
Ashland,Ky. A10	7.125	7.375
Canton,O. R2	7.125	....
Fairfield,Ala. T2	7.125	7.375
Gary,Ind. U5	7.125	7.375
GraniteCity,Ill. G4	7.225	....
Ind.Harbor I-2	7.125	7.375
Irvin,Pa. U5	7.125	7.375
Kokomo,Ind. C16	7.225	....
MartinsFry. W10	7.125	7.375
Pitts.,Calif. C11	7.875	....
Pittsburgh J5	7.125	....
SparrowsPt. B2	7.225	....
Weirton W6	7.125	....

SHEETS, Culvert—Pure Iron

Ind.Harbor,Ind. I-2 ....7.375

SHEETS, Enameling

Ashland,Ky. A10 .....6.775
Cleveland R2 .....6.775
Fairfield,Ala. T2 .....6.775
Gary,Ind. U5 .....6.775
Ind.Harbor,Ind. I-2, Y1 6.775
Irvin,Pa. U5 .....6.775
Middletown,O. A10 ....6.775
Niles,O. M21, S3 .....6.775
SparrowsPoint,Md. B2..6.775
Youngstown Y1 .....6.775

BLUED STOCK, 29 Gage

Dover,O. E6 .....8.70
Ind.Harbor,Ind. I-2 ....8.70
Mansfield,O. E6 .....8.70
Warren,O. R2 .....8.70
Yorkville,O. W10 .....8.70

SHEETS, Long Terne, Steel

Follansbee,W.Va. W10 7.225
Gary,Ind. U5 .....7.225
Mansfield,O. E6 .....7.225
Middletown,O. A10 ....7.225
Niles,O. M21, S3 .....7.225
Warren,O. R2 .....7.225

SHEETS, Long Terne, Ingot Iron

Middletown,O. A10 ....7.625

SHEETS, Aluminum Coated

Butler,Pa. A10 (type 1) 9.525
Butler,Pa. A10 (type 2) 9.625
Irvin,Pa. U5 (type 1) 9.525

SHEETS, Wall Casing

Fontana,Calif. K1 ....7.325
Geneva,Utah C11 .....6.80

SHEETS, Galvanized High-Strength, Low Alloy

Irvin,Pa. U5 .....10.125
Pittsburgh J5 .....10.125
SparrowsPt.(39) B2 ..10.025

SHEETS, Galvannealed Steel

Canton,O. R2 .....7.175
Irvin,Pa. U5 .....7.175

SHEETS, Galvanized Ingot Iron (Hot-Dipped Continuous)

Ashland,Ky. A10 .....7.125
Middletown,O. A10 ....7.125

SHEETS, Electrogalvanized

Canfield,O. C3 .....7.50
Cleveland (28) R2 .....7.65
Niles,O. (28) R2 .....7.65
Weirton,W.Va. W6 ....7.50

SHEETS, Galvanized Steel Hot-Dipped‡

AlabamaCity,Ala. R2 .6.875‡
Ashland,Ky. A10 .....6.875‡
Canton,O. R2 .....6.875‡
Dover,O. E6 .....6.875†
Fairfield,Ala. T2 .....6.875†
Gary,Ind. U5 .....6.875†
GraniteCity,Ill. G4 ..6.975*
Ind.H'rb'r,Ind. I-2, Y1 6.875†
Irvin,Pa. U5 .....6.875†
Kokomo,Ind. C16 ....6.975‡
MartinsFerry,O. W10..6.875*
Middletown,O. A10 ....6.875†
Pittsburg,Calif. C11 ..7.625*
Pittsburgh J5 .....6.875†
SparrowsPt.,Md. B2 ..6.875†
Warren,O. R2 .....6.875†
Weirton,W.Va. W6 ...6.875*

*Continuous and noncontinuous. †Continuous. ‡Noncontinuous. §For minimum spangled add 0.15c.

Key to Producers

A1 Acme Steel Co.
A2 Acme-Newport Steel Co.
A3 Alan Wood Steel Co.
A4 Allegheny Ludlum Steel
A5 Alloy Metal Wire Div., H. K. Porter Co. Inc.
A6 American Shim Steel Co.
A7 American Steel & Wire Div., U. S. Steel Corp.
A8 Anchor Drawn Steel Co.
A9 Angell Nail & Chaplet
A10 Armco Steel Corp.
A11 Atlantic Steel Co.
A25 Algoma Steel Corp. Ltd.

B1 Babcock & Wilcox
B2 Bethlehem Steel Co.
B3 Bethlehem Steel Co., Pacific Coast Div.
B4 Blair Strip Steel Co.
B5 Bliss & Laughlin Inc.
B8 Braeburn Alloy Steel
B9 Brainard Steel Div., Sharon Steel Corp.
B10 E. & G. Brooke. Wickwire Spencer Steel Div., Colo. Fuel & Iron
B12 Buffalo Steel Corp.
B14 A. M. Byers Co.
B15 J. Bishop & Co.

C1 Calstrip Steel Corp.
C2 Calumet Steel Div., Borg-Warner Corp.
C3 Canfield Steel Co.
C4 Carpenter Steel Co.
C9 Colonial Steel Co.
C10 Colorado Fuel & Iron
C11 Columbia-Geneva Steel
C12 Columbia Steel & Shaft.
C13 Columbia Tool Steel Co.
C14 Compressed Steel Shaft.
C15 Connors Steel Div., H. K. Porter Co., Inc.
C16 Continental Steel Corp.
C17 Copperweld Steel Co.
C18 Crucible Steel Co.
C19 Cumberland Steel Co.
C20 Cuyahoga Steel & Wire Div., Hoover Ball & Bearing
C23 Charter Wire Inc.
C24 G. O. Carlson Inc.
C32 Carpenter Steel of N.Eng.

D2 Detroit Steel Corp.
D4 Disston Div., H. K. Porter Co. Inc.
D6 Driver-Harris Co.
D7 Dickson Weatherproof Nail Co.
D8 Damascus Tube Co.
D9 Wilbur B. Driver Co.

E2 Eastern Stainless Steel
E6 Empire-Reeves Steel
E10 Enamel Prod. & Plating

F2 Firth Sterling Inc.
F3 Fitzsimons Steel Co.
F5 Franklin Steel Div., Borg-Warner Corp.
F6 Fretz-Moon Tube Co.
F7 Ft. Howard Steel & Wire
F8 Ft. Wayne Metals Inc.

G4 Granite City Steel Co.
G5 Great Lakes Steel Corp.
G6 Greer Steel Co.
G8 Green River Steel Corp.

H1 Hanna Furnace Corp.
H5 Hercules Drawn Steel
H7 Helical Tube Co.

I-1 Igoe Bros. Inc.
I-2 Inland Steel Co.
I-3 Interlake Iron Corp.
I-4 Ingersoll Steel Div., Borg-Warner Corp.
I-6 Ivins Steel Tube Works
I-7 Indiana Steel & Wire Co.

J1 Jackson Iron & Steel Co.
J3 Jessop Steel Co.
J4 Johnson Steel & Wire Co.
J5 Jones & Laughlin Steel
J6 Joslyn Mfg. & Supply
J7 Judson Steel Corp.
J8 Jersey Shore Steel Co.
J10 Jay Steel Corp.

K1 Kaiser Steel Corp.
K2 Keokuk Electro-Metals
K3 Keystone Drawn Steel
K4 Keystone Steel & Wire
L1 Laclede Steel Co.
L2 LaSalle Steel Co.
L3 Latrobe Steel Co.
L5 Lockhart Iron & Steel
L6 Lone Star Steel Co.
L7 Lukens Steel Co.
L8 Leschen Wire Rope Div., H. K. Porter Co. Inc.

M1 McLouth Steel Corp.
M4 Mahoning Valley Steel
M6 Mercer Pipe Div., Sawhill Tubular Products
M8 Mid-States Steel & Wire
M12 Moltrup Steel Products
M14 McInnes Steel Co.
M16 Md. Fine & Specialty Wire Co. Inc.
M17 Metal Forming Corp.
M18 Milton Steel Div., Merritt-Chapman&Scott
M21 Mallory-Sharon Metals Corp.
M22 Mill Strip Products Co.
M23 Mill Strip Products Co. of Pennsylvania

N1 National Standard Co.
N2 National Supply, Armco Steel Corp.
N3 National Tube Div., U. S. Steel Corp.
N5 Nelsen Steel & Wire Co.
N6 New England High Carbon Wire Co.
N8 Newman-Crosby Steel
N14 Northwest. Steel Rolling Mills Inc.
N15 Northwestern S.&W. Co.
N17 National Steel Corp.
N20 Neville Ferro Alloy Co.

O1 Ohio Ferro-Alloys Corp.
O4 Oregon Steel Mills

P1 Pacific States Steel Corp.
P2 Pacific Tube Co.
P4 Phoenix Steel Corp.
P5 Pilgrim Drawn Steel
P6 Pittsburgh Coke & Chem.
P7 Pittsburgh Steel Co.
P11 Pollak Steel Co.
P12 Portsmouth Div., Detroit Steel Corp.
P13 Precision Drawn Steel
P15 Pittsburgh Metallurgical
P16 Page Steel & Wire Div., American Chain & Cable
P17 Plymouth Steel Corp.
P19 Pitts. Rolling Mills
P20 Prod. Steel Strip Corp.
P22 Phoenix Mfg. Co.
P25 Phil. Steel & Wire Corp.

R2 Republic Steel Corp.
R5 Roebling's Sons, John A.
R6 Rome Strip Steel Co.
R8 Reliance Div., Eaton Mfg.
R9 Rome Mfg. Co.
R10 Rodney Metals Inc.

S1 Seneca Wire & Mfg. Co.
S3 Sharon Steel Corp.
S4 Sharon Tube Co.
S5 Sheffield Div. Armco Steel Corp.
S6 Shenango Furnace Co.
S7 Simmons Co.
S8 Simonds Saw & Steel Co.
S12 Spencer Wire Corp.
S13 Standard Forgings Corp.
S14 Standard Tube Co.
S15 Stanley Works
S17 Superior Drawn Steel Co.
S18 Superior Steel Div., Copperweld Steel Co.
S19 Sweet's Steel Co.
S20 Southern States Steel
S23 Superior Tube Co.
S25 Stainless Welded Prod.
S26 Specialty Wire Co. Inc.
S30 Sierra Drawn Steel Div., Bliss & Laughlin Inc.
S31 Sawhill Tubular Products
S40 Seneca Steel Service
S41 Stainless & Strip Div., J & L Steel Corp.
S42 Southern Elec. Steel Co.
S43 Seymour Mfg. Co.
S44 Screw & Bolt Corp. of America
S45 Somers Brass Co.
S46 Steel Co. of Canada
S47 Seaway Steel Div., Roblin-Seaway Industries

T2 Tenn. Coal & Iron Div. U. S. Steel Corp.
T3 Tenn. Products & Chemical
T4 Texas Steel Co.
T5 Thomas Strip Div., Pittsburgh Steel Co.
T6 Thompson Wire Co.
T7 Timken Roller Bearing
T9 Tonawanda Iron Div., Am. Rad. & Stan. San.
T13 Tube Methods Inc.
T19 Techalloy Co. Inc.

U3 Union Wire Rope, Armco Steel Corp.
U4 Universal-Cyclops Steel
U5 U. S. Steel Corp.
U6 U. S. Pipe & Foundry
U7 Ulbrich Stainless Steels
U8 U. S. Steel Supply Div., U. S. Steel Corp.
U11 Union Carbide Metals Co.
U13 Union Steel Corp.

V2 Vanadium-Alloy Steel
V3 Vulcan Kidd Steel Div., H. K. Porter Co.

W1 Wallace Barnes Steel Div., Associated Spring
W2 Wallingford Steel Co.
W3 Washburn Wire Co.
W4 Washington Steel Corp.
W6 Weirton Steel Div., National Steel Corp.
W8 Western Cold Drawn Steel Div., Standard Screw Co.
W9 Wheatland Tube Co.
W10 Wheeling Steel Corp.
W12 Wickwire Spencer Steel Div., Colo. Fuel & Iron
W13 Wilson Steel & Wire Co.
W14 Wisconsin Steel Div., International Harvester
W15 Woodward Iron Co.
W18 Wyckoff Steel Co.

Y1 Youngstown Sheet & Tube

STRIP

STRIP, Hot-Rolled Carbon

Ala.City,Ala.(27) R2	5.10
Allenport,Pa. P7	5.10
Alton,Ill. L1	5.30
Ashland,Ky.(8) A10	5.10
Atlanta A11	5.10
Bessemer,Ala. T2	5.10
Birmingham C15	5.10
Conshohocken,Pa. A3	5.15
Detroit M1	5.10
Ecorse,Mich. G5	5.10
Fairfield,Ala. T2	5.10
Farrell,Pa. S3	5.10
Fontana,Calif. K1	5.825
Gary,Ind. U5	5.10
Ind.Harbor,Ind. I-2, Y1	5.10
Johnstown,Pa.(25) B2	5.10
Lackaw'na,N.Y.(25) B2	5.10
LosAngeles(25) B3	5.85
LosAngeles C1	8.60
Minnequa,Colo. C10	6.20
Riverdale,Ill. A1	5.10
SanFrancisco S7	6.60
Seattle(25) B3	6.10
Seattle N14	6.60
Sharon,Pa. S3	5.10
S.Chicago,Ill. W14	5.10
S.SanFrancisco(25) B3	5.85
SparrowsPoint,Md. B2	5.10
Torrance,Calif. C11	5.85
Warren,O. R2	5.10
Weirton,W.Va. W6	5.10
Youngstown U5, Y1	5.10

STRIP, Hot-Rolled Alloy

Carnegie,Pa. S18	8.40
Farrell,Pa. S3	8.40
Gary,Ind. U5	8.40
Houston S5	8.65
Ind.Harbor,Ind. Y1	8.40
KansasCity,Mo. S5	8.65
LosAngeles B3	9.60
Lowellville,O. S3	8.40
Newport,Ky. A2	8.40
Sharon,Pa. A2, S3	8.40
S.Chicago,Ill. W14	8.40
Youngstown U5, Y1	8.40

STRIP, Hot-Rolled High-Strength, Low-Alloy

Ashland,Ky. A10	7.575
Bessemer,Ala. T2	7.575
Conshohocken,Pa. A3	7.575
Ecorse,Mich. G5	7.575
Fairfield,Ala. T2	7.575
Farrell,Pa. S3	7.575
Gary,Ind. U5	7.575
Ind.Harbor,Ind. I-2,Y1	7.575
Lackawanna,N.Y. B2	7.575
LosAngeles(25) B3	8.325
Seattle(25) B3	8.575
Sharon,Pa. S3	7.575
S.Chicago,Ill. W14	7.575
S.SanFrancisco(25) B3	8.325
SparrowsPoint,Md. B2	7.575
Warren,O. R2	7.575
Weirton,W.Va. W6	7.575
Youngstown U5, Y1	7.575

STRIP, Hot-Rolled Ingot Iron

Ashland,Ky.(8) A10	5.35
Warren,O. R2	5.875

STRIP, Cold-Rolled Carbon

Anderson,Ind. G6	7.425
Baltimore T6	7.425
Boston T6	7.975
Buffalo S40	7.425
Cleveland A7	7.425
Dearborn,Mich. S3	7.425
Detroit D2, M1, P20	7.425
Dover,O. G6	7.425
Evanston,Ill. M22	7.425
Farrell,Pa. S3	7.425
Follansbee,W.Va. W10	7.425
Fontana,Calif. K1	9.20
FranklinPark,Ill. T6	7.425
Ind.Harbor,Ind. Y1	7.425
Indianapolis S41	7.575
LosAngeles C1, S41	9.30
McKeesport,Pa. E10	7.525
NewBedford,Mass. R10	7.875
NewBritain,Conn. S15	7.875
NewCastle,Pa. B4, M23	7.425
NewHaven,Conn. D2	7.875
NewKensington,Pa. A6	7.425
Pawtucket,R.I. R3, N8	7.975
Philadelphia P24	7.875
Riverdale,Ill. A1	7.425
Rome,N.Y.(32) R6	7.426
Sharon,Pa. S3	7.425
Trenton,N.J.(31) R5	8.875
Warren,O. R2, T5	7.425
Worcester,Mass. A7	7.975
Youngstown S41, Y1	7.425

STRIP, Cold-Rolled Alloy

Boston T6	15.90
Carnegie,Pa. S18	15.55
Cleveland A7	15.55
Dover,O. G6	15.55
Farrell,Pa. S3	15.55
FranklinPark,Ill. T6	15.55
Harrison,N.J. S18	15.55
Indianapolis S41	15.70
LosAngeles S41	17.75
Lowellville,O. S3	15.55
Pawtucket,R.I. S8	15.90
Riverdale,Ill. A1	15.55
Sharon,Pa. S3	15.55
Worcester,Mass. A7	15.85
Youngstown S41	15.55

STRIP, Cold-Rolled High-Strength, Low-Alloy

Cleveland A7	10.80
Dearborn,Mich. S3	10.80
Dover,O. G6	10.80
Farrell,Pa. S3	10.80
Ind.Harbor,Ind. Y1	10.80
Sharon,Pa. S3	10.80
Warren,O. R2	10.80
Weirton,W.Va. W6	10.80
Youngstown Y1	10.80

STRIP, Galvanized (Continuous)

Farrell,Pa. S3	7.50
Sharon,Pa. S3	7.50

STRIP, Cold-Finished Spring Steel (Annealed)

	0.26-0.40C	0.41-0.60C	0.61-0.80C	0.81-1.05C	1.06-1.35C
Anderson,Ind. G6	9.10	....	....	....	....
Baltimore T6	9.50	10.70	12.90	15.90	18.85
Boston T6	9.50	10.70	12.90	15.90	18.85
Bristol,Conn. W1	....	10.70	12.90	16.10	19.30
Carnegie,Pa. S18	8.95	10.40	12.60	15.60	....
Cleveland A7	8.95	10.40	12.60	15.60	18.55
Dearborn,Mich. S3	9.05	10.50	12.70	....	....
Detroit D2	9.05	10.50	12.70	15.70	....
Dover,O. G6	8.95	10.40	12.60	15.60	18.55
Evanston,Ill. M22	9.05	10.40	12.60	15.60	....
Farrell,Pa. S3	8.95	10.40	12.60	15.60	18.55
Fostoria,O. S1	10.05	10.40	12.60	15.60	....
FranklinPark,Ill. T6	9.05	10.40	12.60	15.60	18.55
Harrison,N.J. C18	....	....	12.90	16.10	19.30
Indianapolis S41	9.10	10.55	12.60	15.60	18.55
LosAngeles C1	11.15	12.60	14.80	17.80	....
LosAngeles S41	11.15	12.60	14.80	....	....
NewBritain,Conn. S15	9.40	10.70	12.90	15.90	18.85
NewCastle,Pa. B4, M23	8.95	10.40	12.60	15.60	....
NewHaven,Conn. D2	9.40	10.70	12.90	15.90	....
NewKensington,Pa. A6	8.95	10.40	12.60	15.60	....
NewYork W3	....	10.70	12.90	16.10	19.30
Pawtucket,R.I. N8	9.50	10.70	12.90	15.90	18.85
Riverdale,Ill. A1	9.05	10.40	12.60	15.60	18.55
Rome,N.Y. R6	8.95	10.40	12.60	15.60	18.55
Sharon,Pa. S3	8.95	10.40	12.60	15.60	18.55
Trenton,N.J. R5	....	10.70	12.90	15.90	18.85
Warren,O. T5	8.95	10.40	12.60	15.60	18.55
Worcester,Mass. A7, T6	9.50	10.70	12.90	15.90	18.85
Youngstown S41	8.95	10.40	12.60	15.60	18.55

Spring Steel (Tempered)

	Up to 0.80C	0.81-1.05C	1.06-1.35C
Bristol,Conn. W1	18.85	22.95	27.80
Buffalo W12	18.85	....	....
Fostoria,O. S1	19.05	22.15	....
FranklinPark,Ill. T6	19.20	23.30	28.15
Harrison,N.J. C18	18.85	22.95	27.80
NewYork W3	18.85	22.95	27.80
Palmer,Mass. W12	18.85	....	....
Trenton,N.J. R5	18.85	22.95	27.80
Worcester,Mass. A7, T6	18.85	22.95	27.80
Youngstown S41	19.20	23.30	28.15

STRIP, C. R., Electrogalvanized

Cleveland A7	7.425*
Dover,O. G6	7.425*
Evanston,Ill. M22	7.525*
McKeesport,Pa. E10	7.50*
NewCastle,Pa. M23	7.425*
Riverdale,Ill. A1	7.425*
Warren,O. B9, S3, T5	7.425*
Worcester,Mass. A7	7.975
Youngstown S41	7.425*

*Plus galvanizing extras.

STRIP, Cold-Rolled Ingot Iron

Warren,O. R2	8.175

TIGHT COOPERAGE HOOP

Atlanta A11	5.825
Farrell,Pa. S3	5.525
Riverdale,Ill. A1	5.675
Sharon,Pa. S3	5.525
Youngstown U5	5.525

TIN MILL PRODUCTS

ELECTROLYTIC THIN TIN PLATE (¼ lb coating in coils)

	Basis Weight 45 lb	50 lb	55 lb	60 lb
Fairfield,Ala. T2	$6.10	$6.25	$6.40	$6.55
Fairless,Pa. U5	6.10	6.25	6.40	6.55
Gary,Ind. U5	6.10	6.25	6.40	6.55
IndianaHarbor,Ind. I-2	6.10	6.25	6.40	6.55
Irwin,Pa. U5	6.10	6.25	6.40	6.55
SparrowsPoint,Md. B2	6.10	6.25	6.40	6.55
Weirton,W.Va. W6	6.10	6.25	6.40	6.55

TIN PLATE, Electrolytic 0.25 lb (100 lb basis wt) Coating

Aliquippa,Pa. J5	$9.10
Fairfield,Ala. T2	9.10
Fairless,Pa. U5	9.10
Fontana,Calif. K1	9.75
Gary,Ind. U5	9.10
GraniteCity,Ill. G4	9.20
Ind.Harb.,Ind. I-2, Y1	9.10
Irvin,Pa. U5	9.10
Niles,O. R2	9.10
Pittsburg,Calif. C11	9.75
SparrowsPt.,Md. B2	9.10
Weirton,W.Va. W6	9.10
Yorkville,O. W10	9.10

BLACK PLATE (Base Box)

Aliquippa,Pa. J5	$8.20
Fairfield,Ala. T2	8.20
Fairless,Pa. U5	8.20
Fontana,Calif. K1	8.85
Gary,Ind. U5	8.20
GraniteCity,Ill. G4	8.30
Ind.Harbor,Ind. I-2, Y1	8.20
Irvin,Pa. U5	8.20
Niles,O. R2	8.20
Pittsburg,Calif. C11	8.85
SparrowsPoint,Md. B2	8.20
Weirton,W.Va. W6	8.20
Yorkville,O. W10	8.20

ELECTRO. TIN-COATED SHEET (20-27 gage; per 100 lb)

IndianaHarb.,Ind. Y1	$7.90

(21-27 gage; per 100 lb)

Aliquippa,Pa. J5	$7.90
Niles,O. R2	7.90

TIN PLATE, HOT DIPPED COMMON COKE

	1.25 lb	1.50 lb
Aliquippa,Pa. J5	$10.40	$10.65
Fairfield,Ala. T2	10.40	10.65
Fairless,Pa. U5	10.40	10.65
Fontana,Calif. K1	11.05	11.30
Gary,Ind. U5	10.40	10.65
Irvin,Pa. U5	10.40	10.65
Pitts.,Calif. C11	11.05	11.30
Sp.Pt.,Md. B2	10.40	10.65
Weirton,W.Va. W6	10.40	10.65
Yorkville,O. W10	10.40	10.65

HOLLOWARE ENAMELING (Black plate) (29 Gage)

Aliquippa,Pa. J5	7.85
Gary,Ind. U5	7.85
GraniteCity,Ill. G4	7.95
Ind.Harbor,Ind. Y1	7.85
Irvin,Pa. U5	7.85
Yorkville,O. W10	7.85

SILICON STEEL

C.R. COILS & CUT LENGTHS (22 Ga.)

Fully Processed (Semiprocessed ½c lower)	Field	Armature	Electric	Motor	Dynamo
BeechBottom,W.Va. W10	....	11.70	12.40	13.35	14.65
Brackenridge,Pa. A4	....	....	12.40	13.55	14.65
GraniteCity,Ill. G4	9.975*	11.30*	12.00*	13.15*	....
IndianaHarbor,Ind. I-2	9.875*	11.20*	11.90*	13.05*	....
Mansfield,O. E6	9.875*	11.70	12.40	13.55	14.65
Newport,Ky. A2	9.875	11.70*	12.40*	13.55*	14.65*
Niles,O. M21	9.875*	11.70	12.40	13.55	....
Vandergrift,Pa. U5	9.875*	11.70	12.40	13.55	14.65
Warren,O. R2	9.875*	11.70	12.40	13.55	14.65
Zanesville,O. A10	....	11.70†	12.40	13.55	14.65
Stator					
Mansfield,O. E6					8.10
Vandergrift,Pa. U5					8.10
Warren,O. R2 (Locore)					8.10

SHEETS (22 Ga., coils & cut lengths)

Fully Processed (Semiprocessed ½c lower)	T-72	T-65	T-58	T-52
BeechBottom,W.Va. W10	15.70	16.30	16.80	17.85
Vandergrift,Pa. U5	15.70	16.30	16.80	17.85
Zanesville,O. A10	15.70	16.30	16.80	17.85

C.R. COILS & CUT LENGTHS (22 Ga.)	Grain Oriented T-100	T-90	T-80	T-73	T-66	T-72
Brackenridge,Pa. A4	..	18.10	19.70	20.20	20.70	15.70††
Butler,Pa. A10	....	....	19.70	20.20	20.70	....
Vandergrift,Pa. U5	17.10	18.10	19.70	20.20	20.70	15.70
Warren,O. R2	....	....	....	....	....	15.70‡

*Semiprocessed. †Fully processed only. ‡Coil annealed; semiprocessed ½c lower. ††Coils only.

WIRE

WIRE, Manufacturers Bright, Low Carbon

AlabamaCity,Ala. R2	8.00
Aliquippa,Pa. J5	8.00
Alton,Ill. L1	8.20
Atlanta A1	8.00
Bartonville,Ill. K4	8.10
Buffalo W12	8.00
Chicago W13	8.00
Cleveland A7, C20	8.00
Crawfordsville,Ind. M8	8.10
Donora,Pa. A7	8.00
Duluth A7	8.00
Fairfield,Ala. T2	8.00
Fostoria,O.(24) S1	8.10
Houston S5	8.25
Jacksonville,Fla. M8	8.35
Johnstown,Pa. B2	8.00
Joliet,Ill. A7	8.00
KansasCity,Mo. S5	8.25
Kokomo,Ind. C16	8.10
LosAngeles B3	8.95
Minnequa,Colo. C10	8.25
Monessen,Pa. P7, P16	8.00
N.Tonawanda S47	8.00
Palmer,Mass. W12	8.30
Pittsburg,Calif. C11	8.95
Portsmouth,O. P12	8.00
S.Chicago,Ill. R2	8.00
S.SanFrancisco C10	8.95
SparrowsPoint,Md. B2	8.10
Sterling,Ill.(1) N15	8.00
Sterling,Ill. N15	8.10
Struthers,O. Y1	8.00
Waukegan,Ill. A7	8.00
Worcester,Mass. A7	8.30

WIRE, Cold Heading Carbon

Elyria,O. W8	8.00
N.Tonawanda S47	8.00

WIRE, Gal'd., for ACSR

Bartonville,Ill. K4	12.65
Buffalo W12	13.40
Cleveland A7	12.65
Donora,Pa. A7	12.65
Duluth A7	12.65
Johnstown,Pa.(10) B2	12.65
KansasCity,Mo. U3	12.90
LosAngeles(2) B3	13.60
Minnequa,Colo. C10	12.775
Monessen,Pa. P7, P16	12.65
Muncie,Ind. I-7	13.60
NewHaven,Conn. A7	12.95
Palmer,Mass. W12	13.70
Pittsburg,Calif. C11	13.45
Portsmouth,O. P12	12.65
Roebling,N.J. R5	12.95
SparrowsPt.,Md.(10) B2	12.75
Struthers,O. Y1	13.40
Trenton,N.J. A7	12.95
Waukegan,Ill. A7	12.65
Worcester,Mass. A7	12.95

WIRE, Upholstery Spring

Aliquippa,Pa. J5	9.75
Alton,Ill. L1	9.95
Buffalo W12	9.75
Cleveland A7	9.75
Donora,Pa. A7	9.75
Duluth A7	9.75
Johnstown,Pa. B2	9.75
KansasCity,Mo. S5, U3	10.00
Kokomo,Ind. C16	9.85
LosAngeles B3	10.70
Minnequa,Colo. C10	9.95
Monessen,Pa. P7, P16	9.75
NewHaven,Conn. A7	10.95
Palmer,Mass. W12	10.05
Pittsburg,Calif. C11	10.075
Portsmouth,O. P12	9.75
Roebling,N.J. R5	10.05
S.Chicago,Ill. R2	9.75
S.SanFrancisco C10	10.075
SparrowsPt.,Md. B2	9.85
Struthers,O. Y1	9.75
Trenton,N.J. A7	10.05
Waukegan,Ill. A7	9.75
Worcester,Mass. A7	10.05

WIRE, MB Spring, High-Carbon

Aliquippa,Pa. J5	9.75
Alton,Ill. L1	9.95
Bartonville,Ill. K4	9.85
Buffalo W12	9.75
Cleveland A7	9.75
Donora,Pa. A7	9.75
Duluth A7	9.75
Fostoria,O. S1	9.80
Johnstown,Pa. B2	9.75
KansasCity,Mo. S5, U3	10.00
LosAngeles B3	10.20
Milbury,Mass.(12) N6	10.05
Minnequa,Colo. C10	9.95
Monessen,Pa. P7, P16	9.75
Muncie,Ind. I-7	9.95
Palmer,Mass. W12	10.05
Pittsburg,Calif. C11	10.20
Portsmouth,O. P12	9.75
Roebling,N.J. R5	10.05
S.Chicago,Ill. R2	9.75
S.SanFrancisco C10	10.20
SparrowsPt.,Md. B2	9.85
Struthers,O. Y1	9.75
Trenton,N.J. A7	10.05
Waukegan,Ill. A7	9.75
Wor'ster,Mass. A7,J4,T6	10.05

WIRE, Fine & Weaving(8" Coils)

Alton,Ill. L1	16.50
Bartonville,Ill. K4	16.40
Chicago W13	16.30
Cleveland A7	16.30
Crawfordsville,Ind. M8	16.40
Fostoria,O. S1	16.30
Houston S5	16.55
Jacksonville,Fla. M8	16.65
Johnstown,Pa. B2	16.30
KansasCity,Mo. S5	16.55
Kokomo,Ind. C16	16.30
Minnequa,Colo. C16	16.55
Monessen,Pa. P16	16.30
Muncie,Ind. I-7	16.50
Palmer,Mass. W12	16.60
S.SanFrancisco C10	17.15
Waukegan,Ill. A7	16.30
Worcester,Mass. A7,J6	16.60

ROPE WIRE (A)

Bartonville,Ill. K4	13.45
Buffalo W12	13.45
Fostoria,O. S41	13.45
Johnstown,Pa. B2	13.45
Monessen,Pa. P7	13.45
Muncie,Ind. I-7	13.65
Palmer,Mass. W12	13.75
Portsmouth,O. P12	13.45
Roebling,N.J. R5	13.75
St. Louis L8	13.45
SparrowsPt.,Md. B2	13.55
Struthers,O. Y1	13.45
Worcester,Mass. J4	13.75

(A) Plow and Mild Plow; add 0.25c for Improved Plow.

WIRE, Tire Bead

Bartonville, Ill. K4	17.15
Monessen,Pa. P16	17.15
Roebling,N.J. R5	17.65

WIRE, Cold-Rolled Flat

Anderson,Ind. G6	12.35
Baltimore T6	12.65
Boston T6	12.65
Buffalo W12	12.35
Chicago W13	12.45
Cleveland A7	12.35
Crawfordsville,Ind. M8	12.35
Dover,O. G6	12.35
Evanston,Ill. M22	12.45
Farrell,Pa. S3	12.35
Fostoria,O. S1	12.35
FranklinPark,Ill. T6	12.45
Kokomo,Ind. C16	12.35
Massillon,O. R8	12.35
Milwaukee C23	12.55
Monessen,Pa. P7, P16	12.35
NewCastle,Pa. M23	12.35
Palmer,Mass. W12	12.65
Pawtucket,R.I. N8	12.65
Philadelphia P24	12.65
Riverdale,Ill. A1	12.45
Rome,N.Y. R6	12.35
Sharon,Pa. S3	12.35
Trenton,N.J. R5	12.65
Warren,O. B9	12.35
Worcester,Mass. A7, T6	12.65

NAILS, Stock Sizes

	Col.
AlabamaCity,Ala. R2	173
Aliquippa,Pa. J5	173
Atlanta A11	173
Bartonville,Ill. K4	175
Chicago W13	173
Cleveland A9	173
Crawfordsville,Ind. M8	175
Donora,Pa. A7	173
Duluth A7	173
Fairfield,Ala. T2	173
Houston S5	175
Jacksonville,Fla. M8	175
Johnstown,Pa. B2	173
Joliet,Ill. A7	173
KansasCity,Mo. S5	178
Kokomo,Ind. C16	175
Minnequa,Colo. C10	178
Monessen,Pa. P7	173
Pittsburg,Calif. C11	192
Rankin,Pa. A7	173
S.Chicago,Ill. R2	173
SparrowsPt.,Md. B2	175
Sterling,Ill. (7) N15	175
Worcester,Mass. A7	179

(To Wholesalers: per cwt)

Galveston,Tex. D7	$10.30

NAILS, Cut (100 lb kegs)

Wheeling,W.Va. W10	10.10

POLISHED STAPLES

	Col.
AlabamaCity,Ala. R2	175
Aliquippa,Pa. J5	173
Atlanta A11	173
Bartonville,Ill. K4	175
Crawfordsville,Ind. M8	177
Donora,Pa. A7	173
Duluth A7	173
Fairfield,Ala. T2	173
Houston S5	180
Jacksonville,Fla. M8	177
Johnstown,Pa. B2	173
Joliet,Ill. A7	173
KansasCity,Mo. S5	180
Kokomo,Ind. C16	177
Minnequa,Colo. C10	178
Pittsburg,Calif. C11	194
Rankin,Pa. A7	173
S.Chicago,Ill. R2	175
SparrowsPt.,Md. B2	175
Sterling,Ill.(7) N15	175
Worcester,Mass. A7	179

TIE WIRE, Automatic Baler (14½ Ga.) (per 97 lb net box)
Coil No. 3150

AlabamaCity,Ala. R2	8.78
Atlanta A11	10.36
Bartonville,Ill. K4	8.88
Buffalo W12	10.26
Chicago W13	9.24
Crawfordsville,Ind. M8	8.88
Donora,Pa. A7	8.78
Duluth A7	8.78
Fairfield,Ala. T2	8.78
Houston S5	9.02
Jacksonville,Fla. M8	8.88
Johnstown,Pa. B2	8.78
Joliet,Ill. A7	8.78
KansasCity,Mo. S5	9.02
Kokomo,Ind. C16	8.88
LosAngeles B3	9.20
Minnequa,Colo. C10	8.02
Pittsburg,Calif. C11	9.20
S.Chicago,Ill. R2	8.78
S.SanFrancisco C10	9.20
SparrowsPt.,Md. B2	8.88
Sterling,Ill.(37) N15	8.88

Coil No. 6500 Stand. 100 lb coil

AlabamaCity,Ala. R2	9.06
Atlanta A11	10.70
Bartonville,Ill. K4	9.16
Buffalo W12	10.60
Chicago W13	9.54
Crawfordsville,Ind. M8	9.16
Donora,Pa. A7	9.06
Duluth A7	9.06
Fairfield,Ala. T2	9.06
Houston S5	9.30
Jacksonville,Fla. M8	9.16
Johnstown,Pa. B2	9.06
Joliet,Ill. A7	9.06
KansasCity,Mo. S5	9.30
Kokomo,Ind. C16	9.16
LosAngeles B3	9.50
Minnequa,Colo. C10	9.30
Pittsburg,Calif. C11	9.50
S.Chicago,Ill. R2	9.06
S.SanFrancisco C10	9.50
SparrowsPt.,Md. B2	9.16
Sterling,Ill.(37) N15	9.16

Coil No. 6500 Interim 100 lb coil

AlabamaCity,Ala. R2	9.11
Atlanta A11	10.75
Bartonville,Ill. K4	9.21
Buffalo W12	10.65
Chicago W13	9.59
Crawfordsville,Ind. M8	9.21
Donora,Pa. A7	9.11
Duluth A7	9.11
Fairfield,Ala. T2	9.11
Houston S5	9.35
Jacksonville,Fla. M8	9.21
Johnstown,Pa. B2	9.11
Joliet,Ill. A7	9.11
KansasCity,Mo. S5	9.35
Kokomo,Ind. C16	9.21
LosAngeles B3	9.55
Minnequa,Colo. C10	9.35
Pittsburg,Calif. C11	9.55
S.Chicago,Ill. R2	9.11
S.SanFrancisco C10	9.55
SparrowsPt.,Md. B2	9.21
Sterling,Ill.(37) N15	9.21

BALE TIES, Single Loop

	Col.
AlabamaCity,Ala. R2	212
Atlanta A11	212
Bartonville,Ill. K4	214
Crawfordsville,Ind. M8	214
Donora,Pa. A7	212
Duluth A7	212
Fairfield,Ala. T2	212
Houston S5	217
Jacksonville,Fla. M8	214
Joliet,Ill. A7	212
KansasCity,Mo. S5	217
Kokomo,Ind. C16	214
Minnequa,Colo. C10	217
SparrowsPt.,Md. B2	214
Sterling,Ill.(7) N15	214

WIRE, Barbed

	Col.
AlabamaCity,Ala. R2	193**
Aliquippa,Pa. J5	190§
Atlanta A11	197*
Bartonville,Ill. K4	199
Crawfordsville,Ind. M8	198
Donora,Pa. A7	193†
Duluth A7	193†
Fairfield,Ala. T2	193†
Houston S5	198**
Jacksonville,Fla. M8	198
Johnstown,Pa. B2	196§
Joliet,Ill. A7	193†
KansasCity,Mo. S5	198**
Kokomo,Ind. C16	195†
Minnequa,Colo. C10	198**
Monessen,Pa. P7	196§
Pittsburg,Calif. C11	213†
Rankin,Pa. A7	193†
S.Chicago,Ill. R2	193**
SparrowsPoint,Md. B2	198§
Sterling,Ill.(7) N15	198

WIRE (16 gage)

	An'ld Stone	Galv. Stone
Ala.City,Ala.R2	17.85	19.40**
Aliq'ppa,Pa. J5	17.85	19.65
Bartonville K4	17.95	19.80
Chicago W13	17.85	....
Cleveland A7	17.85	....
Craw'sville M8	17.95	19.80‡‡
Fostoria,O. S1	18.35	19.90†
Houston S5	18.10	19.65**
Jacksonville M8	17.95	19.80‡‡
Johnstown B2	17.85	19.65§
Kan.City,Mo. S5	18.10	....
Kokomo C16	17.95	19.50†
Minnequa C10	18.10	19.65**
P'im'r,Mass. W12	19.10	19.70†
Pitts.,Calif. C11	18.20	19.75†
S.SanFran. C10	18.20	19.75**
SparrowsPt. B2	17.95	19.75§
St'ling(37) N15	17.95	19.80
Waukegan A7	17.85	19.40†
Worcester A7	18.15	....

FENCE POSTS

	Col.
Birmingham C15	177
ChicagoHts.,Ill. C2, I-2	177
Duluth A7	177
Franklin,Pa. F5	177
Johnstown,Pa. B2	177
Marion,O. P11	177
Minnequa,Colo. C10	182
Tonawanda,N.Y. B12	177

WOVEN FENCE, 9-15 Ga.

	Col.
Ala.City,Ala. R2	187**
Aliq'ppa,Pa.9-11½Ga.J5	190§
Atlanta A11	191*
Bartonville,Ill. K4	193
Crawfordsville,Ind. M8	192
Donora,Pa. A7	187†
Duluth A7	187†
Fairfield,Ala. T2	187†
Houston S5	192**
Jacksonville,Fla. M8	192
Johnstown,Pa.(42) B2	190§
Joliet,Ill. A7	187†
KansasCity,Mo. S5	192**
Kokomo,Ind. C16	189†
Minnequa,Colo. C10	192**
Pittsburg,Calif. C11	210†
Rankin,Pa. A1	187†
S.Chicago,Ill. R2	187**
Sterling,Ill.(7) N15	192

WIRE, Merchant Quality 6 to 8 gage

	An'ld	Galv.
Ala.City,Ala. R2	9.00	9.55**
Aliquippa J5	8.65	9.325§
Atlanta(48) A11	9.00	9.75*
Bartonville(48) K4	9.10	9.85
Buffalo W12	9.00	9.55†
Chicago W13	9.00	9.55**
Cleveland A7	9.00	....
CrawfordsvilleM8	9.10	9.80††
Donora,Pa. A7	9.00	9.55†
Duluth A7	9.00	9.55†
Fairfield T2	9.00	9.55
Houston(48) S5	9.25	9.80**
Jack'vill,Fla. M8	9.10	9.80‡‡
Johnstown(48) B2	9.00	9.675§
Joliet,Ill. A7	9.00	9.55†
KansasCity(48)S5	9.25	9.80**
Kokomo(48) S16	9.10	9.65†
LosAngeles B3	9.95	10.625§
Minnequa C10	9.25	9.80**
Monessen(48) P7	8.65	9.35§
Palmer,Mass. W12	9.30	9.85†
Pitts.,Calif. C11	9.95	10.50†
Rankin,Pa. A7	9.00	9.55†
S.Chicago R2	9.00	9.55**
S.SanFran. C10	9.95	10.50**
Spar'wsPt.(48)B2	9.10	9.775§
St'ling(37)(48)N15	9.10	9.80
Struthers,O. Y1	9.00	9.65‡
Worcester,Mass.A7	9.30	9.85†

Based on zinc prices of: *13.50c. †5c. §10c. ‡Less than 10c. ††10.50c. ‡‡11.10c. **Subject to zinc equalization extras.

FASTENERS

SCREWS, NUTS, BOLTS

(Consumer discounts per cent off list prices, plain finishes. For less than full container quantities, add 25 per cent; attaching nuts to bolts in sizes ¼ in. through ⅝ in. diameter through 8 in. in length, price on application. Discounts are determined by the quantity of screws, nuts, and bolts ordered for one destination at one time.)

Base, one keg	43.00
20,000 lb or more	53.00

SCREWS, SETSCREWS

Hex Screws and High Strength Hex Screws, through 1 in. x 12 in.: Base, one keg	43.00
20,000 lb or more	53.00
Hex Screws 1¼ in. diameter and larger: See net price schedule.	
Fillister Head Screws, coarse thread: Packages	+70.00
Bulk	+28.00
Flat Head Screws, coarse thread: Packages	+100.00
Bulk	+52.00
Setscrews, Square Head, Cup-point, coarse thread: Packages	+10.00
Bulk	15.00

(Bulk discounts on fillister, flat head, and set screws apply only to products ordered in these minimum quantities: ¼ in. through ⅝ in. diameter, 15,000 pieces; ¾ in. through ⅝ in. diameter, 5000 pieces; and ¾ in. through 1 in. diameter, 2000 pieces.)

RIVETS

F.o.b. Cleveland and/or freight equalized with Pittsburg, f.o.b. Chicago and/or Birmingham except where equalization is too great. Structural ½ in. larger 12.85 7/16 in. and smaller by 6 in. and shorter, 15% off list.

PRESTRESSED STRAND

(High strength, stress relieved; 7 wire uncoated. Net prices per 1000 ft, 40,000 lb and over.)

	Standard Diameter, Inches 1/4	5/16	3/8	7/16	1/2
Buffalo W12	$26.20	$38.50	$47.90	$61.30	$80.30
KansasCity,Mo. U3	26.20	38.50	47.90	61.30	80.30
Minnequa,Colo. C10	26.20	38.50	47.90	61.30	80.30
Pittsburg,Calif. C11	26.20	38.50	47.90	61.30	80.30
Roebling,N.J. R5	26.20	38.50	47.90	61.30	80.30
SparrowsPoint,Md. B2	26.20	38.50	47.90	61.30	80.30
St.Louis L8	26.20	38.50	47.90	61.30	80.30
Waukegan,Ill. A7	26.20	38.50	47.90	61.30	80.30

BOILER TUBES

Net base c.l. prices, dollars per 100 ft, mill; minimum wall thickness, cut length 10 to 24 ft, inclusive.

O.D. In.	B.W. Gage	Seamless H.R.	Seamless C.D.	Elec. Weld H.R.
1	13	....	27.24	23.12
1¼	13	....	32.25	24.41
1½	13	....	35.65	26.98
1⅝	13	30.42	42.12	31.89
2	13	40.28	47.21	35.74
2¼	13	45.36	58.17	40.26
2½	12	49.24	57.72	43.70
2¾	12	54.23	63.57	48.13
2½	12	58.73	68.83	52.13
2¾	12	62.62	73.40	55.59
3	12			

RAILWAY MATERIALS

Rails	Standard No. 1	Standard No. 2	All No. 2	Too Rails 60 lb Under
Bessemer,Pa. U5	5.75	5.65	....	6.725
Ensley,Ala. T2	5.75	5.65	....	6.725
Fairfield,Ala. T2	....	....	....	6.725
Gary,Ind. U5	5.75	5.65	....	....
Huntington,W.Va. C15	....	....	....	6.725
Johnstown,Pa. B2	....	....	....	(16) 6.725
Lackawanna,N.Y. B2	5.75	5.65	....	6.725
Minnequa,Colo. C10	5.75	5.65	....	7.725
Steelton,Pa. B2	5.75	5.65	....	....

TIE PLATES

Fairfield,Ala. T2	6.875
Gary,Ind. U5	6.875
Lackawanna,N.Y. B2	6.875
Minnequa,Colo. C10	6.875
Seattle B3	7.025
Steelton,Pa. B2	6.875
Torrance,Calif. C11	7.025

JOINT BARS

Bessemer,Pa. U5	7.25
Fairfield,Ala. T2	7.25
Joliet,Ill. U5	7.25
Lackawanna,N.Y. B2	7.25
Minnequa,Colo. C10	7.25
Steelton,Pa. B2	7.25

AXLES

Ind.Harbor,Ind. S13	9.125
Johnstown,Pa. B2	9.125

SCREW SPIKES

Lebanon,Pa. B2	15.10

TRACK BOLTS, Untreated

Cleveland R2	15.35
KansasCity,Mo. S5	15.35
Lebanon,Pa. B2	15.35
Minnequa,Colo. C10	15.35
Pittsbugh S44	15.35
Seattle B3	15.85

STANDARD TRACK SPIKES

Fairfield,Ala. T2	10.10
Ind.Harbor,Ind. I-2, Y1	10.10
KansasCity,Mo. S5	10.10
Lebanon,Pa. B2	10.10
Minnequa,Colo. C10	10.10
Pittsburgh J5	10.10
Seattle B3	10.60
S.Chicago, Ill. R2	10.10
Struthers,O. Y1	10.10
Youngstown R2	10.10

FOOTNOTES

(1) Chicago base.
(2) Double galvanized.
(3) Merchant.
(4) Reinforcing.
(5) 1½ to under 1 7/16 in.; 1 7/16 to under 1 15/16 in., 6.70c; 1 13/16 to 8 in., inclusive, 7.05c.
(6) Limited analyses only.
(7) Chicago base 2 cols. lower.
(8) 16 Ga. and heavier.
(9) Merchant quality; add 0.35c for special quality.
(10) Bethany A coating.
(12) Worcester, Mass., base.
(15) ⅜" and thinner.
(16) 40 lb and under.
(17) Plate only; 0.25 in. & heavier.
(23) Special quality.
(24) Deduct 0.05c, finer than 15 Ga.
(25) Bar mill bands.
(27) Bar mill sizes.
(28) Bonderized.
(30) Sheared; for universal mill add 0.45c.
(31) Widths over ⅝ in.; 7.375c, for widths ⅝ in. and under by 0.125 in. and thinner.
(32) Buffalo base.
(33) 14 Ga., 48 in.
(35) 72" and narrower.
(36) 54" and narrower.
(37) Chicago base, 10 points lower.
(38 13 Ga. & lighter 60" & narrower.
(39) 48" and narrower.
(43) 9-14½ Ga.
(44) To fabricators.
(48) 6-7 Ga.
(49) 3⅛ in. and smaller rounds and 2⅛ in. and smaller hexagons; 9.625c for larger rounds and hexagons and other shapes.

SEAMLESS STANDARD PIPE, Threaded and Coupled

Carload discounts from list, %

Size—Inches	2		2½		3		3½		4		5		6	
List Per Ft	37c		58.5c		76.5c		92c		$1.09		$1.48		$1.92	
Pounds Per Ft	3.68		5.82		7.62		9.20		10.89		14.81		19.18	
	Blk	Galv*	Blk	Galv*	Blk	Galv*	Blk	Galv*	Blk	Galv*	Blk	Galv*	Blk	Galv*
Aliquippa, Pa. J5	+12.25	+28.75	+5.75	+23.5	+3.25	+21	+1.75	+19.5	+1.75	+19.5	+2	+19.75	0.5	+17.25
Ambridge, Pa. N2	+12.25	....	+5.75	....	+3.25	....	+1.75	....	+1.75	....	+2	....	0.5	....
Lorain, O. N3	+12.25	+28.75	+5.75	+23.5	+3.25	+21	+1.75	+19.5	+1.75	+19.5	+2	+19.75	0.5	+17.25
Youngstown Y1	+12.25	+28.75	+5.75	+23.5	+3.25	+21	+1.75	+19.5	+1.75	+19.5	+2	+19.75	0.5	+17.25

ELECTRICWELD STANDARD PIPE, Threaded and Coupled

Carload discounts from list, %

Youngstown R2	+12.25	+28.75	+5.75	+23.5	+3.25	+21	+1.75	+19.5	+1.75	+19.5	+2	+19.75	0.5	+17.25

BUTTWELD STANDARD PIPE, Threaded and Coupled

Carload discounts from list, %

Size—Inches	⅛		¼		⅜		½		¾		1		1¼	
List Per Ft	5.5c		6c		6c		8.5c		11.5c		17c		23c	
Pounds Per Ft	0.24		0.42		0.57		0.85		1.13		1.68		2.28	
	Blk	Galv*	Blk	Galv*	Blk	Galv*	Blk	Galv*	Blk	Galv*	Blk	Galv*	Blk	Galv*
Aliquippa, Pa. J5	....	....	....	....	....	....	2.25	+15	5.25	+11	8.75	+6.5	11.25	+5.25
Alton, Ill. L1	....	....	....	....	....	....	0.25	+17	3.25	+13	6.75	+8.5	9.25	+7.25
Benwood, W. Va. W10	....	....	....	....	....	....	2.25	+15	5.25	+11	8.75	+6.5	11.25	+5.25
Butler, Pa. F6	4.5	+24	+8.5	+34	+19.5	+44	....	....	....	....	....	....	....	....
Etna, Pa. N2	....	....	....	....	....	....	2.25	+15	5.25	+11	8.75	+6.5	11.25	+5.25
Fairless, Pa. N3	....	....	....	....	....	....	0.25	+17	3.25	+13	6.75	+8.5	9.25	+7.25
Fontana, Calif. K1	....	....	....	....	....	....	+10.75	+28	+7.75	+24	+4.25	+19.5	+1.75	+18.25
Indiana Harbor, Ind. Y1	....	....	....	....	....	....	1.25	+16	4.25	+12	7.75	+7.5	10.25	+6.25
Lorain, O. N3	....	....	....	....	....	....	2.25	+15	5.25	+11	8.75	+6.5	11.25	+5.25
Sharon, Pa. S4	4.5	+24	+8.5	+34	+19.5	+44	....	....	....	....	....	....	....	....
Sharon, Pa. M6	....	....	....	....	....	....	2.25	+15	5.25	+11	8.75	+6.5	11.25	+5.25
Sparrows Pt., Md. B2	2.5	+26	+10.5	+36	+21.5	+46	0.25	+17	3.25	+13	6.75	+8.5	9.25	+7.25
Wheatland, Pa. W9	4.5	+24	+8.5	+34	+19.5	+44	2.25	+15	5.25	+11	8.75	+6.5	11.25	+5.25
Youngstown R2, Y1	....	....	....	....	....	....	2.25	+15	5.25	+11	8.75	+6.5	11.25	+5.25

Size—Inches	1½		2		2½		3		3½		4	
List Per Ft	27.5c		37c		58.5c		76.5c		92c		$1.09	
Pounds Per Ft	2.75		3.68		5.82		7.62		9.20		10.89	
	Blk	Galv*	Blk	Galv*	Blk	Galv*	Blk	Galv*	Blk	Galv*	Blk	Galv*
Aliquippa, Pa. J5	11.75	+4.25	12.25	+3.75	13.75	+3.5	13.75	+3.5	3.25	+14.5	3.25	+14.5
Alton, Ill. L1	9.75	+6.25	10.25	+5.75	11.75	+5.5	11.75	+5.5	1.25	+16.5	1.25	+16.5
Benwood, W. Va. W10	11.75	+4.25	12.25	+3.75	13.75	+3.5	13.75	+3.5	3.25	+14.5	3.25	+14.5
Etna, Pa. N2	11.75	+4.25	12.25	+3.75	13.75	+3.5	13.75	+3.5	3.25	+14.5	3.25	+14.5
Fairless, Pa. N3	9.75	+6.25	10.25	+5.25	11.75	+5.5	11.75	+5.5	1.25	+16.5	1.25	+16.5
Fontana, Calif. K1	+1.25	+17.25	+0.75	+16.75	0.75	+16.5	0.75	+16.5	+9.75	+27.5	+9.75	+27.5
Indiana Harbor, Ind. Y1	10.75	+5.25	11.25	+4.75	12.75	+4.5	12.75	+4.5	2.25	+15.5	2.25	+15.5
Lorain, O. N3	11.75	+4.25	12.25	+3.75	13.75	+3.5	13.75	+3.5	....	....	....	....
Sharon, Pa. M6	11.75	+4.25	12.25	+3.75	13.75	+3.5	13.75	+3.5	3.25	+14.5	3.25	+14.5
Sparrows Pt., Md. B2	9.75	+6.25	10.25	+5.75	11.75	+5.5	11.75	+5.5	1.25	+16.5	1.25	+16.5
Wheatland, Pa. W9	11.75	+4.25	12.25	+3.75	13.75	+3.5	13.75	+3.5	3.25	+14.5	3.25	+14.5
Youngstown R2, Y1	11.75	+4.25	12.25	+3.75	13.75	+3.5	13.75	+3.5	3.25	+14.5	3.25	+14.5

*Galvanized pipe discounts based on price of zinc at 11.50c, East St. Louis.

Stainless Steel

Representative prices, cents per pound; subject to current lists of extras

AISI Type	Rerolling Ingot	Rerolling Slabs	Forging Billets	H.R. Strip	H.R. Rods; C.F. Wire	Bars; Structural Shapes	Plates	Sheets	C.R. Strip; Flat Wire
201	22.75	25.00	....	36.00	41.50	43.50	39.25	48.50	43.50
202	24.75	28.25	37.75	39.00	42.25	44.50	40.00	49.25	46.75
301	24.00	26.00	38.75	37.25	43.50	46.00	41.25	51.25	45.00
302	26.25	29.50	39.50	40.50	44.25	46.75	42.25	52.00	49.50
302B	26.50	30.75	42.25	45.75	46.75	49.00	44.50	57.00	57.00
303	....	33.25	42.50	....	47.25	49.75	45.00	56.75	56.75
304	28.00	29.50	39.50	40.50	44.25	46.75	42.25	52.00	49.50
304L	....	37.25	47.25	48.25	52.00	54.50	50.00	59.75	57.25
305	29.50	34.75	44.00	47.50	47.00	49.50	46.25	58.75	58.75
308	32.00	36.25	49.00	50.25	54.75	57.75	55.25	63.00	63.00
309	41.25	47.50	60.00	64.50	66.25	69.50	66.00	80.50	80.50
310	51.50	59.50	81.00	84.25	89.75	94.50	87.75	96.75	96.75
314	....	....	80.50	....	89.75	94.50	87.75	....	104.25
316	41.25	47.50	64.50	68.50	71.75	75.75	71.75	80.75	76.75
316L	....	55.25	72.25	76.25	79.50	83.50	79.50	88.50	84.50
317	49.75	58.00	79.75	88.25	89.50	94.25	88.50	101.00	101.00
321	33.50	38.00	48.75	53.50	54.50	57.50	54.75	65.50	62.25
330	....	....	123.25	....	98.75	143.75	135.00	149.25	149.25
18-8 Cb-Ta	38.50	48.25	57.75	63.50	63.75	67.25	64.75	79.25	75.25
403	....	....	26.75	....	29.75	31.50	30.00	40.25	40.25
405	20.25	26.50	30.75	36.00	34.75	36.50	32.50	46.75	46.75
410	17.50	19.50	26.75	31.00	29.75	31.50	30.00	40.25	40.25
416	....	....	29.75	....	33.75	35.50	31.25	48.25	48.25
420	....	31.50	35.50	41.75	40.75	42.75	40.25	62.00	62.00
430	17.75	19.75	29.75	32.00	33.75	35.50	31.00	40.75	38.75
430F	....	....	30.50	....	34.25	36.00	31.75	51.75	42.00
431	....	29.75	39.25	....	43.50	46.00	41.00	56.00	56.00
446	....	....	40.75	59.00	46.00	48.25	42.75	70.00	70.00

Producers Are: Allegheny Ludlum Steel Corp.; American Steel & Wire Div., U. S. Steel Corp.; Anchor Drawn Steel Co., division of Vanadium-Alloys Steel Co.; Armco Steel Corp.; Babcock & Wilcox Co.; Bethlehem Steel Co.; J. Bishop & Co.; A. M. Byers Co.; Calstrip Steel Corp.; G. O. Carlson Inc.; Carpenter Steel Co.; Carpenter Steel Co. of New England; Charter Wire Products; Crucible Steel Co. of America; Damascus Tube Co.; Dearborn Div., Sharon Steel Corp.; Wilbur B. Driver Co.; Driver-Harris Co.; Eastern Stainless Steel Corp.; Firth Sterling Inc.; Fort Wayne Metals Inc.; Green River Steel Corp., subsidiary of Jessop Steel Co.; Indiana Steel & Wire Co.; Ingersoll Steel Div., Borg-Warner Corp.; Elwood Ivins Steel Tube Works Inc.; Jessop Steel Co.; Johnson Steel & Wire Co. Inc.; Stainless & Strip Div., Jones & Laughlin Steel Corp.; Joslyn Stainless Steels, division of Joslyn Mfg. & Supply Co.; Latrobe Steel Co.; Lukens Steel Co.; Maryland Fine & Specialty Wire Co. Inc.; McLouth Steel Corp.; Metal Forming Corp.; Midvale-Heppenstall Co.; National Standard Co.; National Tube Div., U. S. Steel Corp.; Pacific Tube Co.; Page Steel & Wire Div., American Chain & Cable Co. Inc.; Phoenix Steel Corp.; Pittsburgh Rolling Mills Inc.; Republic Steel Corp.; Riverside-Alloy Metal Div., H. K. Porter Company Inc.; Rodney Metals Inc.; Sawhill Tubular Products Inc.; Sharon Steel Corp.; Simonds Saw & Steel Co.; Somers Brass Co.; Specialty Wire Co. Inc.; Standard Tube Co.; Superior Steel Div., Copperweld Steel Co.; Superior Tube Co.; Swepco Tube Corp.; Techalloy Co. Inc.; Timken Roller Bearing Co.; Trent Tube Co., subsidiary of Crucible Steel Co. of America; Tube Methods Inc.; Ulbrich Stainless Steels, Inc.; Union Steel Corp.; U. S. Steel Corp.; Universal Cyclops Corp.; Vanadium-Alloy Steel Co., Wall Tube & Metal Products Co.; Wallingford Steel, subsidiary of Allegheny Ludlum Steel Corp.; Washington Steel Corp.; Seymour Mfg. Co.

Clad Steel

	Plates: Carbon Base 5%	10%	15%	20%	Sheets: Carbon Base 20%
Stainless					
302	....	....	....	....	37.50
304	26.05	28.80	31.55	34.30	39.75
304L	30.50	33.75	36.95	40.15	....
316	38.20	42.20	46.25	50.25	58.25
316L	42.30	46.75	51.20	55.65	....
316 Cb	49.90	55.15	60.40	65.65	....
321	31.20	34.50	37.75	41.05	47.25
347	36.90	40.80	44.65	48.55	57.00
405	22.25	24.60	26.90	29.25	....
410	20.55	22.70	24.85	27.00	....
430	21.20	23.45	25.65	27.90	....
Inconel	49.80	61.35	72.80	84.40	....
Nickel	43.20	55.05	66.95	78.90	....
Nickel, Low Carbon	43.50	55.70	67.95	80.35	....
Monel	44.25	55.35	66.45	77.60	....

	Strip, Carbon Base —Cold Rolled— 10%	Both Sides
Copper*	36.10	43.00

*Deoxidized. Production points: Stainless-clad sheets, New Castle, Ind. I-4; stainless-clad plates, Claymont, Del. P4; Coatesville, Pa. L7; New Castle, Ind. I-4, and Washington, Pa. J3; nickel, inconel, monel-clad plates, Claymont, Del. P4; Coatesville L7; copper-clad strip, Carnegie, Pa. S18.

Tool Steel

Grade	$ per lb	Grade	$ per lb
Reg. Carbon (W-1)	0.330	Hi-Carbon-Cr (D-11)	0.955
Spec. Carbon (W-1)	0.385	V-Cr Hot Work (H-13)	0.550
Oil Hardening (O-1)	0.505	W-Cr Hot Work (H-12)	0.530
V-Cr Hot Work (H-11)	0.505	W Hot Wk (H-21)	1.425-1.44

Grade by Analysis (%) W	Cr	V	Co	Mo	AISI Designation	$ per lb
18	4	1	....	....	T-1	1.840
18	4	2	....	....	T-2	2.005
13.5	4	3	....	....	T-3	2.105
18.25	4.25	1	4.75	....	T-4	2.545
18	4	2	9	....	T-5	2.915
20.25	4.25	1.6	12.95	....	T-6	4.330
13.75	3.75	2	5	....	T-8	2.485
1.5	4	1	....	8.5	M-1	1.200
6.4	4.5	1.9	....	5	M-2	1.345
6	4	3	....	6	M-3	1.590

Tool steel producers include: A4, A8, B2, B8, C4, C9, C13, C18, F2, J3, L3, M14, S8, U4, V2, and V3.

Pig Iron

Prices in dollars per gross ton, f.o.b. (rail) furnace; add 50 cents when shipped by truck. Maximum delivered prices are approximate and based on rail shipment.

	Basic	No. 2 Foundry	Malle-able	Besse-mer
Birmingham District				
Birmingham R2	62.00	62.50**	66.50	....
Birmingham U6	....	62.50**	66.50	....
Woodward, Ala. W15	62.00*	62.50**	66.50	....
Cincinnati, deld.	....	70.20	....	....
Buffalo District				
Buffalo H1, R2	66.00	66.50	67.00	67.50
NorthTonawanda, N.Y. T9	....	66.50	67.00	67.50
Tonawanda, N.Y. W12	66.00	66.50	67.00	67.50
Boston, deld.	77.29	77.79	78.29	....
Rochester, N.Y., deld.	69.02	69.52	70.02	....
Syracuse, N.Y., deld.	70.12	70.62	71.12	....
Chicago District				
Chicago I-3	66.00	66.50	66.50	67.00
SouthChicago, Ill. R2	66.00	66.50	66.50	67.00
SouthChicago, Ill. W14	66.00	....	66.50	67.00
Milwaukee, deld.	68.81	69.31	69.31	69.81
Muskegon, Mich., deld.	....	74.46	74.46	....
Cleveland District				
Cleveland R2, A7	66.00	66.50	66.50	67.00
Akron, Ohio, deld.	69.52	70.02	70.02	70.52
Mid-Atlantic District				
Birdsboro, Pa. B10	68.00	68.50	69.00	69.50
Chester, Pa. P4	Nom.	Nom.	Nom.	....
Swedeland, Pa. A3	68.00	68.50	69.00	69.50
NewYork, deld.	....	75.41	75.91	....
Newark, N J., deld.	72.53	73.03	73.53	74.03
Philadelphia, deld.	70.18	70.68	71.18	71.68
Troy, N.Y. R2	68.00	68.50	69.00	69.50
Boston, deld.	75.20	75.70	76.20	76.70
Pittsburgh District				
NevilleIsland, Pa. P6	66.00	66.50	66.50	67.00
Pittsburgh (N&S sides), deld.	....	68.31	68.31	68.81
Monaca, Pa., deld.	....	68.33	68.33	68.83
Lawrenceville, W. Homestead, Wilmerding, Pa., deld.	....	68.68	68.68	69.18
Verona, Trafford, Pa., deld.	68.83	69.33	69.33	69.83
Brackenridge, Pa., deld.	69.16	69.66	69.66	70.16
Midland, Pa. C18	66.00	....	....	....
Youngstown District				
Hubbard, Ohio Y1	....	....	66.50	....
Sharpsville, Pa. S6	66.00	....	66.50	67.00
Youngstown Y1	....	....	66.50	....
Other U. S. Districts				
Duluth I-3	66.00	66.50	66.50	67.00
Erie, Pa. I-3	66.00	66.50	66.50	67.00
Fontana, Calif. K1	75.00	75.50	....	....
Geneva, Utah C11	66.00	66.50	....	....
GraniteCity, Ill. G4	67.90	68.40	68.90	....
Ironton, Utah C11	66.00	66.50	....	....
Minnequa, Colo. C10	68.00	68.50	69.00	....
Rockwood, Tenn. T3	62.00	62.50‡	66.50	67.00
Toledo, Ohio I-3	66.00	66.50	66.50	67.00
Cincinnati, deld.	72.94	73.44	....	....
Mansfield, Ohio, deld.	....	....	71.34	....
Canadian District				
Hamilton, Ont. S46	65.00	65.00	65.50	....
PortColborne, Ont. A25	65.00	65.00	65.50	66.00
SaultSte. Marie, Ont. A25	65.00	65.00	65.50	66.00

*Phos. 0.70-0.90%; Phos. 0.30-0.69%, $63.
**Phos. 0.70-0.90%; Phos. 0.30-0.69%, $63.50.
‡Phos. 0.50% up; Phos. 0.30-0.49%, $63.50.

PIG IRON DIFFERENTIALS

Silicon: Add 75 cents per ton for each 0.25% Si or percentage thereof over base grade, 1.75-2.25%, except on low phos. iron on which base is 1.75-2.00%. Foundry grade, 1.75% or under, deduct 50c.

Manganese: Add 50 cents per ton for each 0.25% manganese over 1% or portion thereof.

BLAST FURNACE SILVERY PIG IRON, Gross Ton

(Base 6.01-6.50% silicon; add 75c for each 0.50% silicon or portion thereof over the base grade within a range of 6.50 to 13%; starting with silicon over 13% add $1 per ton for each 0.50% silicon or portion thereof up to 14%; over 14%, price is $93 with $1 differential; add $1 for each 0.50% Mn over 1%)

Buffalo H1	$79.25
Jackson, Ohio I-3, J1	78.00
PortColborne, Ont. A25	78.50
Toledo, Ohio I-3	78.00

ELECTRIC FURNACE SILVERY IRON, Gross Ton

(Base 14.01-14.50% silicon; add $1 for each 0.50% Si to 18%; $1.25 for each 0.50% Mn over 1%; $2 per gross ton premium for 0.045% max P)

CalvertCity, Ky. P15	$99.00
NiagaraFalls, N.Y. P15	99.00
Keokuk, Iowa Open-hearth & Fdry, K2	89.00
Keokuk, Iowa O.H. & Fdry, 12½ lb piglets, 16% Si, K2	92.00

LOW PHOSPHORUS IRON, Gross Ton

Birdsboro, Pa. B10 (Phos. 0.075% max)	$73.00
Lyles, Tenn. T3 (Phos. 0.035% max)	73.00
Rockwood, Tenn. T3 (Phos. 0.035% max)	73.00
Buffalo H1 (Intermediate) (0.036-0.075% max)	71.50
Chicago I-3 (Phos. 0.075% max)	71.00
Cleveland A7 (Intermediate) (Phos. 0.036-0.075% max)	71.00
Duluth I-3 (Phos. 0.075% max)	71.00
Erie, Pa. I-3 (Phos. 0.075% max)	71.00
NevilleIsland, Pa. P6 (Intermediate) (Phos. 0.036-0.075% max)	71.00
Swedeland, Pa. A3 (Intermediate) (Phos. 0.036-0.075% max)	71.00
Troy, N.Y. R2 (Phos. 0.075% max)	73.00

Steel Service Center Products

Representative prices, cents per pound, f.o.b. warehouse, for 2000 lb orders. Prices will vary with total weight of the order. City delivery charges are 15 cents per 100 lb except: Denver, 20 cents; Baltimore, Boston, New York, Philadelphia, San Francisco, 10 cents; Atlanta, Birmingham, Dallas, Houston, Los Angeles, Seattle, no charge.

	SHEETS			STRIP	BARS				PLATES	
	Hot Rolled	Cold Rolled	Galv.	Hot Rolled	H.R. Rounds	C.F. Rounds	H.R. Alloy 4140	STRUCTURAL SHAPES	Carbon	Floor
Atlanta	9.37	10.61	11.85	10.85	9.53	13.24	....	9.94	9.73	11.16
Baltimore	9.50	10.26	10.06	11.25	9.65	11.70	16.38	9.85	9.60	11.10
Birmingham	8.46	10.20	10.59	9.45	8.26	13.14	16.65	8.47	8.41	10.05
Boston	9.90	10.40	11.52	12.40	10.05	13.35	16.59	10.50	9.83	11.55
Buffalo	9.30	10.05	11.80	11.70	9.45	11.45	16.30	9.90	9.40	11.80
Charlotte, N. C.	9 95	11.22	10.55	11.35	10.00	12.68	....	10.20	9.95	11.75
Chicago	9.22	10.20	10.13	11.39	9.22	10.65	15.95	9.57	9.06	11.35
Cincinnati	9.38	10.26	10.18	11.71	9.33	11.53	16.27	10.14	9.44	11.68
Cleveland	9.22	10.66	10.92	11.51	9.33	11.25	16.06	9.96	9.30	11.59
Dallas	9.07	9.88	11.75	10.63	8.48	12.98	16.95	8.71	8.31	9.68
Detroit	9.48	10.46	10.50	11.76	9.53	11.01	16.23	10.14	9.43	11.61
Denver	9.41	11.77	12.11	9.86	10.10	11.47	....	10.02	9.69	11.83
Houston	8.67	9.48	11.35	10.23	8.08	13.10	16.55	8.31	8.00	9.28
Indianapolis	9 66	10.64	10.57	11.83	9.66	11.09	16.39	10.01	8.20	11.79
KansasCity	9.21	10.87	11.35	10.87	9.31	11.57	15.72	9.80	9.10	....
Los Angeles	10 35	11.20	12.10	12.40	10.25	14.20	17.35	10.45	10.30	12.30
Memphis, Tenn.	9.63	10.35	10.80	11.29	9.48	12.70	16.53	9.87	9.32	11.18
Milwaukee	9.36	10.34	10.27	11.53	9.36	10.89	16.09	9.78	9.20	11.49
Moline, Ill.	9.57	10.55	10.48	11.74	9.57	11.00	16.30	9.92	9.41	11.70
Newark, N. J.	9.81	10.34	11.54	12.37	10.05	13.25	16.40	10.35	9.79	11.82
New York	10.07	10.78	11.35	12.37	10.44	13.25	16.40	10.90	10.22	11.82
Philadelphia	9.50	10.00	10.66	11.25	9.65	11.95	16.38	9.85	9.60	11.10
Pittsburgh	9.22	10.53	11.68	11.49	9.22	11.25	15.95	9.57	9.06	11.35
Portland, Oreg.	10.40	12.25	12.35	12.40	10.40	16.65	17.85	11.00	10.55	12.70
St. Louis	9 42	10.58	10.51	11.59	9.44	11.28	16.33	9.80	9.28	11.59
St. Paul	8 82	9.49	10.64	10.99	8.82	11.49	16.54	9.17	8.66	10.95
San Francisco	10.65	11.65	11.75	12.70	10.55	15.10	17.25	11.10	10.80	12.95
Seattle	11.35	12.45	13.40	12.80	10.80	16.20	17.85	11.50	10.95	13.60
Spokane, Wash.	11.20	12.30	13.25	12.65	10.65	16.20	17.85	11.35	10.80	13.45

Specifications: Hot rolled sheet, sheared edge, 10 Ga. & 36 x 96-120 in.; cold rolled sheets, 20 Ga. & 36 x 96-120 in.; galvanized sheets, 10 Ga. x 36 x 120 in. except Los Angeles, Dallas and Houston, 10 Ga. x 48 x 120 in.; hot rolled strip, ¼ in. x 1 in.; hot rolled carbon bars, rounds, ⅜ in.—1¼ in., M1020; cold finished bars, 1 in., C1018; hot rolled alloy bars, 4140 annealed, 1⅝ in.—2⅞ in. rounds; structural shapes, I beams, 6 x 12½ in.; carbon plate, sheared, through ½ in. x 84 in.; floor plates, ¼ in. x 36 in.

Refractories

Fire Clay Brick (per 1000 pieces*)

High-Heat Duty: Ashland, Grahn, Hitchins, Olive Hill, Ky., Athens, Troup, Tex., Clearfield, Curwensville, Lumber, Orviston, West Decatur, Winburne, Snow Shoe, Pa., Bessemer, Ala., Farber, Mexico, St. Louis, Vandalia, Mo., Ironton, Oak Hill, Parrall, Portsmouth, Ohio, Ottawa, Ill., Stevens Pottery, Ga., Canon City, Colo., Frostburg, Md., $133; Templeton, Pa., $135; Salina, Pa., $138; Niles, Ohio, $139; Lehi, Utah, $175.

Super-Duty: Ironton, Ohio, St. Louis, Mexico, Vandalia, Mo., Olive Hill, Ky., Clearfield, Salina, Winburne, Snow Shoe, Pa., New Savage, Frostburg, Md., $200; Stevens Pottery, Ga., $210; Troup, Tex., $215; Lehi, Utah, $263.

Silica Brick (per 1000 pieces*)

Standard: Alexandria, Claysburg, Mt. Union, Sproul, Hawstone, Thompsontown, Pa., Ensley, Ala., Portsmouth, Ohio, St. Louis, $158; Warren, Niles, Windham, Ohio, $163; E. Chicago, Ind., Joliet, Ill., $168; Canon City, Colo., $173; Lehi, Utah, $183; Los Angeles, $185.

Semisilica Brick (per 1000 pieces*)

Woodbridge, N. J., Canon City, Colo., $133; Philadelphia, Clearfield, Pa., $138; Warren, Ohio, $148.

Ladle Brick (per 1000 pieces*)

Dry-Pressed: Aisey, Ill., Johnstown, Pa., Vandalia, Mo., $97; Chester, New Cumberland, W. Va., Freeport, Vanport, Merrill Station, Clearfield, Pa., Wellesville, Irondale, New Salisbury, Ohio, $100; Portsmouth, Ohio, $102; St. Louis, Mexico, Mo., $120; Lehi, Utah, $175.

High-Alumina Brick (per 1000 pieces*)

50 *Per Cent:* St. Louis, Mexico, Vandalia, Mo. $250; Danville, Ill., $253; Fords, N. J., Philadelphia, $265; Clearfield, Pa., $230; Orviston, Snow Shoe, Pa., Frostburg, Md., $260; Troup, Tex., $265.

60 *Per cent:* St. Louis, Mexico, Vandalia, Mo., $310; Danville, Ill., $313; Clearfield, Orviston, Snow Shoe, Pa., Frostburg, Md., $320; Troup, Tex., Fords, N. J., Philadelphia, $325.

70 *Per cent:* St. Louis, Mexico, Vandalia, Mo., $350; Danville, Ill., $353; Clearfield, Orviston, Snow Shoe, Pa., Frostburg, Md., $360; Troup Tex., Fords, N. J., Philadelphia, $365.

Tar Bonded Brick (per ton)

Dolomite: Nario, Ohio, $87.50. Dolomite-Magnesite: Hays, Pa., Hammond, Ind., $107; Nario, Ohio, $109.50. Magnesite: Nario, Ohio, $128; Hays, Pa., Hammond, Ind., $130.

Sleeves (per 1000)

St. Louis, $193; Reesdale, Johnstown, Bridgeburg, St. Charles, Pa., $188; Ottawa, Ill., $205.

Nozzles (per 1000)

Johnstown, Bridgeburg, St. Charles, Pa., St. Louis, $310; Reesdale, Pa., $355.

Runners (per 1000)

Johnstown, Bridgeburg, St. Charles, Clearfield, Pa., $234; Reesdale, Pa., $245.

Dolomite (per ton)

Domestic, dead-burned bulk, Billmeyer, Blue Bell, Williams, Plymouth Meeting, York, Pa., Millville, W. Va., Bettsville, Millersville, Martin, Woodville, Gibsonburg, Nario, Ohio, $16.75; Thornton, McCook, Ill., $17; Dolly Siding, Mo., $15.60.

Magnesite (per net ton)

Domestic, dead-burned, ½ in. grains with fines, Chewelah, Wash., $46; minus ⅝ in. grains bulk, Luning, Nev., $46; ⅝ in. grains with fines (periclase), Baltimore, $73, Pascagoula, Miss., $90.

*—9 in. x 4½ x 2.50 straights.

Canadian Steel

(Cents per lb, f.o.b. mill, except as otherwise noted)

Billets, Blooms & Slabs:

Carbon (N.T.):
- Forging $97.00
- Rerolling 78.00
- Alloy (N.T.) 115.00

Wire Rods:
- Carbon 5.70
- Alloy 6.40

Wire (carload lots):
- Merchant annealed . 8.40
- Low carbon indus. . 7.20
- Upholstery spring .. 8.55
- M.B. spring 8.85

Bars & Small Shapes:
- Carbon, merchant .. 5.30
- Carbon, special 5.85
- Alloy 6.40

Bar Mill Brands:
- Carbon 5.40
- Alloy 8.05

Bars, Reinforcing ... 5.30

Structural Shapes:
- Standard carbon ... 5.50
- Angles & zees 5.40

Plates, Carbon:
- Sheared 5.45
- Universal mill 5.10

Sheets & Coils, Hot Rolled:
- Carbon sheet 4.95
- Carbon strip 5.00

Sheets & Coils, Cold Rolled:
- Carbon sheet 6.35
- Carbon strip:
  - (0.080 and lighter) 6.35
  - (0.081 and heavier) 6.35

Sheets & Coils, Galvanized:
- Standard quality ... 6.70
- Culvert quality 7.00

Sheets, Porcelain Enameling 7.45

Sheets & Coils, Electrical:
- Field grade 9.00
- Electrical grade 10.15

Sheet Piling 6.15
Skelp 4.70
Rails, Heavy 5.55
Rails, Light 5.70
Joint Bars 6.55
Tie Plates 6.35
Grinding Balls (3 in. diam.) 7.00
Tin Mill Products (Per base box; 100 lb base wt)
- Coke tin plate (1.25 lb pot yield) $10.60
- Electrolytic tin plate (0.25 lb coating). 9.10
- Black plate 8.30

Nails, Wholesale:
Carload lots ....Col. 110

Fluorspar

Metallurgical grades, f.o.b. shipping point in Ill., Ky., net tons, carloads, effective CaF_2 content 72.5%, $37-$41; 70%, $36-$40; 60%, $33-$36.50. Imported, net ton, f.o.b. cars point of entry, duty paid, metallurgical grade: European, $30-$33, contract; Mexican, all rail, duty paid, $29-$29.50; barge, Brownsville, Tex., $30-$31.

Metal Powder

(Per pound f.o.b. shipping point in ton lots for minus 100 mesh, except as noted.)

	Cents
Sponge Iron, domestic and foreign, 98% Fe, min, trucklots, freight allowed east of Mississippi River:	
100 mesh, bags	11.50
100 mesh, pails	9.85‡
40 mesh bags	7.50††
Electrolytic Iron, Melting stock, 99.9% Fe, irreg. fragments, ⅛ in. x 1.3 in.	27.75
(In contract lots of 750 tons price is 22.75c.)	
Annealed, 99.5% Fe...36.75, ton deld. east of Mississippi.	
Unannealed (99+% Fe)	33.0
Unannealed (99+% Fe) (minus 325 mesh) ...	58.0
Carbonyl Iron: 90-99.9%, 3 to 20 microns, depending on grade, 88.00-700.00 in standard 200-lb containers; all minus 200 mesh.	
Aluminum: Atomized, 600-lb drum freight allowed, c.l. 42.80; ton lots	41.80
Brass, 80/20, leaded (60 mesh)	37.80
Bronze powder, 90/10.	56.80
Copper, all types	15.00*
Lead	7.50*
Manganese, 500 lb and up	25.00*
Nickel, all types ...	0.78-1.06
Nickel-Silver	56.00
Solder	7.00*
Stainless Steel, 304 ...	89.00
Stainless Steel, 316 ...	$1.07
Steel, AISI 4600	32.00
Tin	14.00*
Zinc	23.20
Cobalt:	Dollars
98.5%, minus 100-300 mesh ..	1.57-1.58
99.5% below 5 microns	2.32
Molybdenum	4.35

*Plus cost of metal. ‡Depending on mesh. §Cutting and scarfing grades. **Depending on price of ore. ††Welding grade.

Imported Steel

(Base per 100 lb, landed, duty paid; based on current ocean rates with any rise for buyer's acc't. Source of shipment: Western Europe, except as noted.)

	North Atlantic	Great Lakes	South Atlantic	Gulf Coast	West Coast
Deformed Bars, Intermediate, ASTM-A 305 ...	$5.55	$5.60	$5.50	$5.40	$5.70
Bar Size Angles	5.85	5.90	5.80	5.70	6.00
Structural Angles	5.75	5.80	5.70	5.60	5.90
I-Beams	5.75	5.90	5.70	5.60	6.00
Channels	5.75	5.90	5.80	5.70	6.00
Plates (basic bessemer)	5.65	5.70	5.60	5.50	5.80
Sheets, hot rolled and galvanized	Nom.	....	Nom.	Nom.	Nom.
Furring Channels, C.R., 1000 ft; ⅞ x 0.30 lb per ft	23.66	23.72	23.59	23.31	25.04
Barbed Wire (†)	6.25	6.30	6.20	6.10	6.40
Merchant Bars	6.05	6.10	6.00	5.90	6.20
Hot-Rolled Bands	6.05	6.10	6.00	5.90	6.20
Wire Rods, Thomas No. 5 (Niederrhein)	5.80*	....	5.75	5.75	6.00
Wire Rods, O.H., No. 5 (Niederrheim)	6.00*	....	5.95	5.95	6.20
Wire Rods, O.H. (Sumitomo, Japan)	5.95	....	5.90	5.90	6.05
Bright Common Wire Nails (§)	7.30	7.35	7.25	7.15	7.45

†Per 82 lb net reel. §Per 100-lb keg, 20d nails and heavier. *Except Boston.

Ores

Lake Superior Iron Ore

(Prices effective for the 1961 shipping season, subject to later revision, gross ton, 51.50% iron natural, rail of vessel, lower lake ports.)

Mesabi nonbessemer	$11.45
Mesabi bessemer	11.60
Old Range nonbessemer	11.70
Old Range bessemer	11.85
Open-hearth lump	12.70
High phos.	11.48

Based on upper lake rail freight rates, lake vessel freight rates, handling and unloading charges, and taxes thereon, which were in effect Jan. 1, 1961; increases or decreases after that date are absorbed by the seller.

Eastern Local Iron Ore

New Jersey, concentrates ..... nom.

Foreign Iron Ore

Cents per unit

Swedish basic, 65%, c.i.f. Atlantic ports	25.00†
Chilean, 62-65%, c.i.f. Atlantic ports .	22.00
Brazilian (lump), 68.5%, f.o.b. vessel, Victoria, per ton	$11.50

Tungsten Ore

Net ton, unit

Foreign wolframite, good commercial quality	$15.75-16.25*
Domestic, concentrates, f.o.b. milling points	22.00-23.00

Manganese Ore

Mn 46-48%, Indian, 85-90c, nom. per long ton unit, c.i.f. U. S. ports, duty for buyer's account.

Chrome Ore

Gross ton, f.o.b. cars New York, Philadelphia, Baltimore, Charleston, S. C., plus ocean freight differential for delivery to Portland, Oreg., Tacoma, Wash.

Indian and Rhodesian

48% 3:1	$34.00-35.00†
48% no ratio	25.00-26.00†

South African Transvaal

44% no ratio	18.75
48% no ratio	24.00-26.00†

Turkish

48% 3:1	35.00-37.00†

Domestic

Rail nearest seller

18% 3:1	30.00

Molybdenum

Sulfide concentrate, per lb of Mo content, mines, unpacked	$1.40

Antimony Ore

Per short ton unit of Sb content, c.i.f. seaboard	
55-60%	$3.00-3.50
60-65%	3.60-4.00

Vanadium Ore

Cents per lb V_2O_5

Domestic	31.00

*Before duty. †Nominal.

Metallurgical Coke

Price per net ton

Beehive Ovens

Connellsville, Pa. furnace	$14.75-15.25
Connellsville, Pa. foundry	18.00-18.50

Oven Foundry

Birmingham, ovens	$30.35
Cincinnati, deld.	33.34
Buffalo, ovens	32.00
Chattanooga, Tenn., ovens	30.80
Detroit, ovens	32.00
Pontiac, Mich., deld.	34.05
Saginaw, Mich., deld.	35.63
Erie, Pa., ovens	32.00
Indianapolis, ovens	31.25
Ironton, Ohio, ovens	30.50
Cincinnati, deld.	33.64
Kearny, N. J., ovens	31.25
Milwaukee, ovens	32.00
Neville Island (Pittsburgh), Pa., ovens..	30.75
New Haven, Conn., ovens	31.00
Painesville, Ohio, ovens	32.00
Cleveland, deld.	34.45
Philadelphia, ovens	31.00
St. Louis, ovens	33.00
St. Paul, ovens	31.25
Chicago, deld.	34.78
Swedeland, Pa., ovens	31.00
Terre Haute, Ind., ovens	31.25

Coal Chemicals

(Representative prices)

Cents per gal f.o.b. tank cars or tank trucks, plant.

Pure benzene	34.00
Xylene, industrial grade	29.00
Creosote	24.00
Naphthalene, 78 deg.	6.06
Toluene, one deg. (deld. east of Rockies)	25.00

Cents per lb, f.o.b. tank cars or tank trucks, deld.

Phenol, 90 per cent grade	14.75

Per ton bulk, f.o.b. cars or trucks, plant.

Ammonium sulfate, regular grade	$32.00

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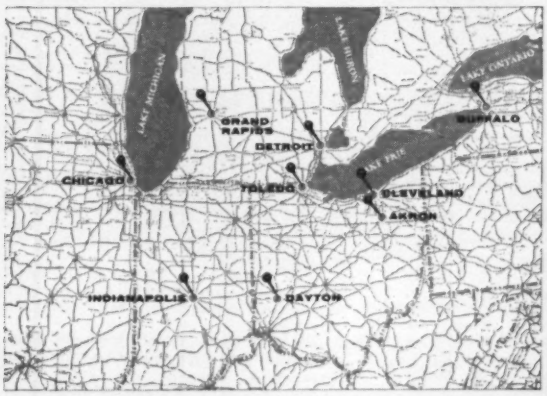

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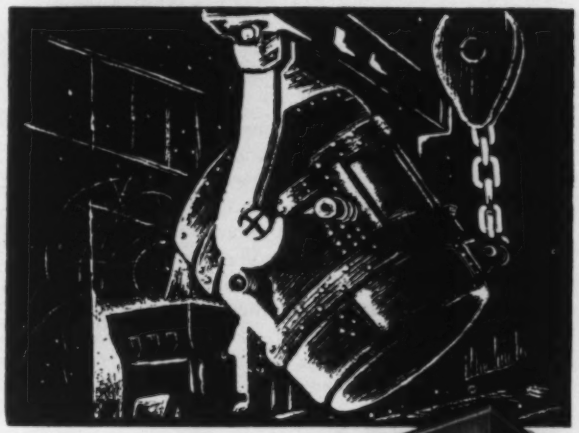

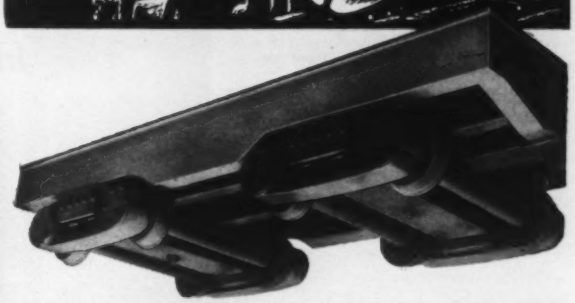

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New Aluminum Products Offered Extrusion Trade

Aluminum Co. of America, Pittsburgh, is offering four new products for the extrusion industry—a variety of extrusion alloy 6063 and three other alloys heretofore unavailable in ingot form.

The new version of standard extrusion alloy 6063—known as extrusion alloy C914—offers advantages where a matte finish is desired. Receptive to hard anodic coatings, C914 is designed for producing a wide range of hues, including shades of bronze, black, and gray.

Extrusion alloy C58, now available in ingot form, is suited for extrusions to be porcelain enameled; alloy 6563 is said to be capable of being anodized to a brighter, more uniform, reflective finish than other moderate strength extrusion alloys; alloy 4543 is used to make architectural extrusions requiring a gray finish.

Structural Shapes . . .

Structural Shape Prices, Page 201

While structural demand is tapering seasonally, it's still fairly active. October volume will at least parallel that in September. Public work dominates, but there's a diversity of other types of construction before the market.

Mill deliveries continue easy. Wide flange structurals are still available in two to four weeks, standard shapes in even less time.

Bethlehem Steel Co. has started erection of the western tower for the $325 million Verrazano-Narrows Bridge in New York, which will have the longest suspension span in the world. The tower will require 27,000 tons of steel, with 1 million, high strength bolts required in assembly. The main bridge will require 160,000 tons of structural steel, 28,000 tons of reinforcing steel, and 142,500 miles of wire.

The administrative code of the city of New York has been amended to permit use of ASTM A-36 steel in building construction.

STRUCTURAL SHAPES . . .

STRUCTURAL STEEL PLACED

2500 tons, plant addition, Lukens Steel Co., Coatesville, Pa., to Belmont Iron Works, Eddystone, Pa.

800 tons, Montana State bridge at Missoula, to Pacific Coast Div., Seattle, Bethlehem Steel Co.; Sletten Construction Co., Great Falls, Mont., general contractor at $988,381.

570 tons, Christiana High School, Newark, Del., through Rupert Construction Co., general contractor, to Cantley & Co., Philadelphia.

STRUCTURAL STEEL PENDING

2000 tons, transmission tower steel; bids postponed to Oct. 31, to the Bonneville Power Administration, Portland, Oreg.

964 tons, state bridgework, Allegheny County, Pennsylvania, Dinardo Inc., Pittsburgh, low on the general contract.

550 tons and 20 tons of reinforcing bars, repairs to Magnolia bridge; bids to Seattle Oct. 18.

590 tons, four state bridges, Montour County, Pennsylvania, Lycoming Construction Co., Williamsport, Pa., low on the general contract.

372 tons, two state bridges, Indiana County, Pennsylvania, Bertocie Construction Co., Perryopolis, Pa., low on the general contract.

REINFORCING BARS . . .

REINFORCING BARS PLACED

300 tons, pipeline for Everett, Wash., subcontract to United Concrete Pipe Corp., Auburn, Wash.

200 tons, municipal parking garage, Atlantic City, N. J., through Nasset Building Co., general contractor, Atlantic City, to Bethlehem Steel Co., Bethlehem, Pa.

150 tons, junior-senior high school, Elizabethtown, Pa., through Lambert & Intreri, general contractor, Harrisburg, Pa., to Bethlehem Steel Co., Bethlehem, Pa.

REINFORCING BARS PENDING

500 tons, two additions, Swedish Hospital, Seattle; general bids in.

475 tons, also 35 tons of shapes, Washington State, Portage Bay bridge, Seattle; general contract to MacRae Bros. Construction Co., Seattle, low at $2,291,805.

345 tons, state bridgework, Washington County, Pennsylvania; bids Oct. 27.

335 tons, Idaho State, six road structures, Bonneville County; Max A. Boesiger, Mountain Home, low at $481,191.

200 tons, Beebe Bridge, Columbia River; bids to Olympia, Wash., Oct. 17.

104 tons, state bridgework, Adams-York counties, Pennsylvania; bids Oct. 27.

100 tons, Washington State, King County project; bids to Olympia, Wash., Oct. 24.

100 tons, Washington State, Snohomish County, overcrossing; bids to Olympia, Wash., Oct. 24.

PLATES . . .

PLATES PLACED

1000 tons, 48 in. water main, Woodhaven Boulevard, Queens County, New York, went concrete construction to Lock Joint Pipe Co., East Orange, N. J.

450 tons, 10,400 ft of 30 in. ¼ in. plates, water supply line to Hydraulic Supply Mfg. Co., Seattle, low at $149,703, to Port Townsend, Wash.

334 tons, high tensile, Navy Purchasing Office, Washington, to Enterprise Galvanizing Co., Philadelphia; also, 82 tons, grade Hy-80 to U. S. Steel Corp., Pittsburgh; bid Sept. 13.

300 tons, 11,000 ft of concrete cylinder water transmission line, Everett, Wash., subcontract to United Concrete Pipe Corp., Auburn, Wash.; general contract to Harold Kaeser Co., Seattle, low at $472,455.

210 tons, Military Industrial Supply Agency, Navy, Philadelphia, to Pines Steel Co., New York.

(*Please turn to Page 219*)

Iron Ore Statistics—August, 1961

Iron Ore Inentory—August, 1961
(Gross tons; all sources)

	U. S. Ores		Canadian Ores		Foreign Ores	Total
	L. Sup.	Other	L. Sup.	Other		
At U. S. Furnaces						
Start of Month	32,713,715	3,744,577	1,574,671	3,511,698	16,270,746	57,776,072
End of Month						
Mass., N. Y.	2,922,586	12,740	217,700	152,998	267,492	3,573,516
Pennsylvania	6,802,016	395,120	18,523	178,153	8,142,989	15,536,801
Md., Va., W. Va.	700,278	11,004	.....	1,508,782	2,428,834	4,648,898
Ky., Tenn., Tex.	330,687	174,478	.....	374,538	63,954	943,657
Alabama	871	1,656,602	.....	96,311	3,444,544	5,198,328
Ohio	9,277,315	21,540	866,749	1,563,802	1,194,415	12,923,821
Indiana	8,173,663	28,578	498,671	.....	42,242	8,743,154
Illinois	4,828,383	43,203	56,432	.....	194,430	5,122,448
Mich., Minn.	3,718,101	.....	289,581	49,845	301,477	4,359,004
Colo., Utah, Calif.	.....	943,699	.....	.....	10,991	954,690
Undistributed	1,093	2,336	.....	.....	729	4,158
Total-Monthend	36,754,993	3,289,300	1,947,656	3,924,429	16,092,097	62,008,475
At U. S. Docks	2,422,428	.....	215,327	901,841	2,261,938	5,801,534
Total U. S. Stocks	39,177,421	3,289,300	2,162,983	4,826,270	18,354,035	67,810,009

Iron Ore Consumption—August, 1961
(Gross tons; all sources)

	U. S. Ores		Canadian Ores		Foreign Ores	Total
	L. Sup.	Other	L. Sup.	Other		
In U. S.						
Mass., N. Y.	434,357	24,688	25,916	34,651	35,722	555,334
Pennsylvania	857,995	259,505	638	47,188	797,850	1,963,176
Md., Va., W. Va.	146,640	14,949	.....	332,401	400,567	894,557
Ky., Tenn., Tex.	55,066	87,928	.....	42,442	43,198	228,634
Alabama	.....	376,328	.....	6,790	164,646	547,764
Ohio	1,017,899	12,056	61,913	145,062	165,714	1,402,644
Indiana	1,032,722	.....	147,296	.....	25,021	1,205,039
Illinois	551,177	40,596	11,452	.....	31,099	634,324
Mich., Minn.	567,806	.....	75,912	14,987	25,935	684,640
Colo., Utah, Calif.	.....	650,585	.....	.....	.....	650,585
Undistributed	149	124	.....	.....	126	399
In U. S.						
Blast furnaces	3,153,828	979,766	183,659	242,534	558,298	5,118,085
Steel furnaces	136,862	53,411	15,888	18,397	425,345	649,903
Sintering	1,372,970	433,582	123,580	362,590	702,710	2,995,432
Miscellaneous	151	.....	.....	.....	3,525	3,676
Total U. S.	4,663,811	1,466,759	323,127	623,521	1,689,878	8,767,096
In Canada						
Blast furnaces	293,776	.....	124,541	83,626	.....	501,943
Steel furnaces	.....	.....	.....	24,961	7,325	32,286
Sintering	70,381	.....	14,852	23,832	.....	109,065
Total Canada	364,157	.....	139,393	132,419	7,325	643,294
Total U. S.-Canada	5,027,968	1,466,759	462,520	755,940	1,697,203	9,410,390

Data from American Iron Ore Association.

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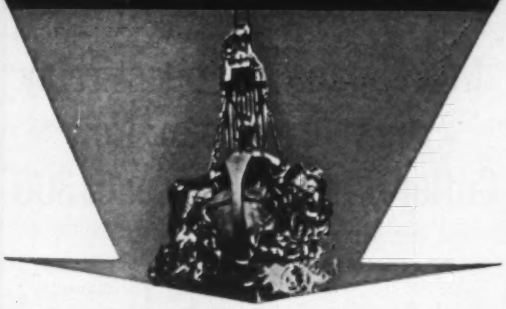

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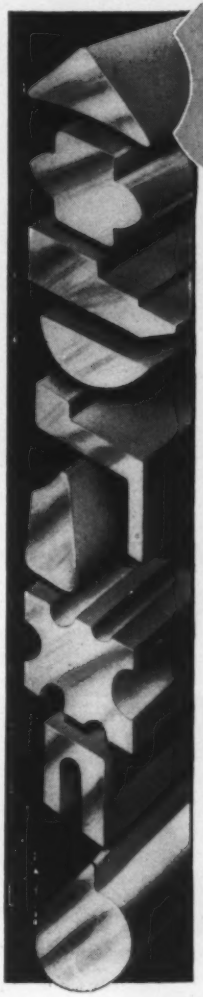

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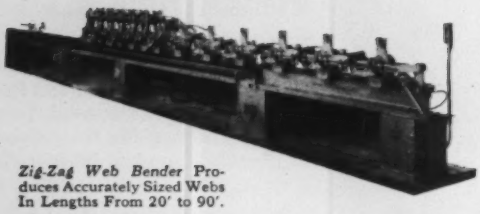

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The Zig-Zag Web Bender obsoletes every other method of producing webs for joists by bending webbing faster and with greater accuracy.

One or two men can operate the Zig-Zag Web Bender and produce several times the output possible with old fashioned bending.

Depth, pitch and radius of bends are precise and consistent in their precision in every bend, resulting in fewer slow-ups on the welding line.

For complete technical details on the Zig-Zag Web Bender write to:

*10' Long—16" High—12" Pitch

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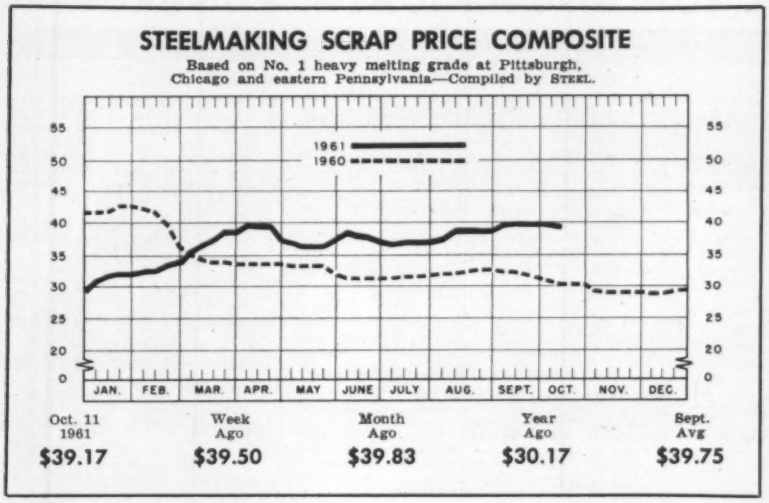


Scrap Price Index Pointed Down

The market is easy at some points; strong domestic demand is lacking, and steel operations are not coming up to expectations. Exports are holding up

Scrap Prices, Page 212

• **Chicago**—The weaker tone that has developed in the scrap market has resulted in markdowns of $1-$2 a ton throughout most of the list. Failure of steelmaking to surge upward this month, as had been predicted, is the chief factor contributing to the slower market.

• **Philadelphia**—Domestic demand is slower, and prices on No. 1 bundles and No. 1 busheling are off to $43, delivered. Prices on couplers, springs, and wheels, however, are stronger at $46. Export trading is fairly well sustained.

• **New York**—Scrap supply and demand appear to be in fair balance, and brokers' buying prices are holding unchanged. Buying is supported mainly by export orders, which offset an easing in domestic business.

• **Pittsburgh** — The market has broken sharply in the wake of lower bids on industrial and railroad lists. No. 1 factory bundles from GM's Fisher Body Div. brought $42.60 a ton, $3 less than last month. Reason: A local consumer announced before the sale that he had put another blast furnace on and would not take Fisher's scrap unless the price dropped considerably. Bids on the more popular grades of railroad scrap were off 50 cents to $1 a ton. Unprepared grades dropped $2 to $4.

• **Cleveland**—While prices on the steelmaking grades are off about $2 a ton on appraisal, there's no buying of consequence to test the market. The lower prices largely reflect the drop in bid prices at the start of the month on automotive factory bundles. Prices on the cast iron grades are also soft. With steel operations less robust than had been predicted for this period, further easing in prices will not be surprising.

• **Youngstown**—Railroad scrap lists closed at $41-$42, which is $1 under the motor lists, and $2 to $3 under the previous railroad lists.

• **Detroit**—Except for some activity in flashings, the market is quiet. Brokers and dealers anticipate further softness pending settlement of the automotive labor trouble. Export orders are phasing out now that the shipping season is nearing a close.

• **Buffalo**—The market is easier, reflecting weakness in other areas and the lack of heavy buying by local mills. One mill bought No. 2 bundles last week, and two other area mills are taking deliveries of No. 2 bundles. Action on No. 1 steel is light but is expected to improve soon.

• **Cincinnati**—The market on the secondary grades is showing signs of weakening. No. 2 heavy melting is off $1 a ton at $28-$29. No. 1 heavy melting material is expected to hold steady on support from a local mill's October buying program.

• **St. Louis**—The market here is showing signs of weakness, and prices on some grades are off $1 to $2 a ton. Springboards that were reportedly being paid by local mills for remote area scrap are no longer being offered with scrap flowing more easily.

• **Birmingham** — Prices are unchanged from a week ago. Some dealers report that the local market is beginning to reflect the weakness that has developed at other market centers the last week or so.

• **Houston**—An easier tone prevails in the local market, reflecting heavier intake and lackluster export demand. Texas mills purchased October delivery tonnage last month.

• **Seattle**—Prices are firm in a fairly active market. Exporters are confronted with two problems: Shortages of good grades and overseas shipping space. Demand for export material exceeds supply, and shippers are pressed to meet their commitments.

Congestion at Japanese ports, Tokyo and Osaka particularly, is a serious problem. Some ships have been idle for six weeks awaiting cargo discharge; berths and lighters are unavailable. As a result, full cargo charters have increased from $70,000 to $80,000 or more for 9500 tons, free load and discharge.

• **San Francisco** — Shipments to Japan through this port this quarter will be only a little less than they were in the preceding three months and in the like period of 1960. Nine or ten shiploads are expected to

(*Please turn to Page* 219)

Iron and Steel Scrap

Consumer prices per gross ton, except as otherwise noted, including brokers' commission, as reported to STEEL, Oct. 11, 1961. *Changes shown in italics.*

STEELMAKING SCRAP COMPOSITE

Oct. 11	$39.17
Oct. 4	39.50
Sept. Avg.	39.75
Oct. 1960	30.04
Oct. 1956	57.27

Based on No. 1 heavy melting grade at Pittsburgh, Chicago, and eastern Pennsylvania.

PITTSBURGH

No. 1 heavy melting	37.00-38.00
No. 2 heavy melting	29.00-30.00
No. 1 dealer bundles	38.00-39.00
No. 2 bundles	27.00-28.00
No. 1 busheling	37.00-38.00
No. 1 factory bundles	*44.00-45.00*
Machine shop turnings	15.00-16.00
Mixed borings, turnings	15.00-16.00
Shovel turnings	20.00-21.00
Cast iron borings	19.00-20.00
Cut structurals:	
2 ft and under	43.00-44.00
3 ft and under	40.00-41.00
Heavy turnings	31.00-32.00
Punchings & plate scrap	45.00-46.00
Electric furnace bundles	*42.00-43.00*

Cast Iron Grades (F.o.b. shipping point)

No. 1 cupola	34.00-35.00
Stove plate	34.00-35.00
Unstripped motor blocks	24.00-25.00
Clean auto cast	35.00-36.00
Drop broken machinery	47.00-48.00‡

Railroad Scrap

No. 1 R.R. heavy melt.	43.00-44.00
Rails, 2 ft and under	*51.00-52.00*
Rails, 18 in. and under	*52.00-53.00*
Random rails	46.00-47.00
Angles, splice bars	*44.00-45.00*
Railroad specialties	48.00-49.00
Rails, rerolling	*58.00-59.00*

Stainless Steel Scrap

18-8 bundles & solids	190.00-195.00
18-8 turnings	115.00-120.00
430 bundles & solids	90.00-95.00
410 turnings	55.00-60.00

CHICAGO

No. 1 hvy melt., indus.	*40.00-41.00*
No. 1 hvy melt., dealer	*38.00-39.00*
No. 2 hvy melting	*33.00-34.00*
No. 1 factory bundles	*43.00-44.00*
No. 1 dealer bundles	*40.00-41.00*
No. 2 bundles	*24.00-25.00*
No. 1 busheling, indus.	*40.00-41.00*
No. 1 busheling, dealer	*38.00-39.00*
Machine shop turnings	*18.00-19.00*
Mixed borings, turnings	*20.00-21.00*
Shovel turnings	*20.00-21.00*
Cast iron borings	*20.00-21.00*
Cut structurals, 3 ft	*46.00-47.00*
Punchings & plate scrap	*48.00-49.00*

Cast Iron Grades

No. 1 cupola	*42.00-43.00*
Stove plate	*38.00-39.00*
Unstripped motor blocks	*34.00-35.00*
Clean auto cast	*47.00-48.00*
Drop broken machinery	*47.00-48.00*

Railroad Scrap

No. 1 R.R. heavy melt.	*42.00-43.00*
R.R. malleable	*47.00-48.00*
Rails, 2 ft and under	*50.00-51.00*
Rails, 18 in. and under	*52.00-53.00*
Angles, splice bars	*45.00-46.00*
Axles	*56.00-57.00*
Rails, rerolling	*60.00-61.00*

Stainless Steel Scrap

18-8 bundles, solids	*185.00-190.00*
18-8 turnings	*105.00-110.00*
430 bundles & solids	*90.00-95.00*
430 turnings	*50.00-55.00*

BUFFALO

No. 1 heavy melting	32.00-33.00
No. 2 heavy melting	26.00-27.00
No. 1 bundles	32.00-33.00
No. 2 bundles	24.00-25.00
No. 1 busheling	32.00-33.00
Shovel turnings	17.00-18.00
Machine shop turnings	13.00-14.00
Cast iron borings	15.00-16.00
Low phos. structurals and plates, 2 ft and under	40.00-41.00

Cast Iron Grades (F.o.b. shipping point)

No. 1 cupola	37.00-38.00
No. 1 machinery	44.00-45.00

Railroad Scrap

Rails, random lengths	43.00-44.00
Rails, 3 ft and under	49.00-50.00
Railroad specialties	42.00-43.00
Rails, rerolling	64.00-65.00

CLEVELAND

No. 1 heavy melting	*36.00-37.00*
No. 2 heavy melting	24.00-25.00†
No. 1 factory bundles	*41.00-42.00*
No. 1 bundles	*36.00-37.00*
No. 2 bundles	23.00-24.00†
No. 1 busheling	*36.00-37.00*
Machine shop turnings	15.00-16.00
Shovel turnings	19.00-20.00
Mixed borings, turnings	19.00-20.00
Cast iron borings	19.00-20.00
Cut foundry steel	*35.50-36.50*
Cut structurals, plate 2 ft and under	*41.00-42.00*
Low phos, punchings & plate	*37.00-38.00*
Alloy free, short shovel turnings	20.00-21.00
Electric furnace bundles	*37.00-38.00*

Cast Iron Grades

No. 1 cupola	*37.00-38.00*
Charging box cast	26.00-27.00
Heavy breakable cast	*26.00-27.00*
Stove plate	*34.00-35.00*
Unstripped motor blocks	*29.00-30.00*
Brake shoes	37.00-38.00
Clean auto cast	*42.00-43.00*
Burnt cast	*30.00-31.00*
Drop broken machinery	*45.00-46.00*

Railroad Scrap

R.R. malleable	50.00-51.00
Rails, 2 ft and under	50.00-51.00
Rails, random lengths	47.00-48.00
Rails, 18 in. and under	52.00-53.00
Cast steel	*39.00-40.00*
No. 1 railroad cast	*44.00-45.00*
Railroad specialties	46.00-47.00
Angles, splice bars	*44.00-45.00*
Rails, rerolling	*55.00-56.00*

Stainless Steel Scrap (Brokers' buying prices; f.o.b. shipping point)

18-8 bundles, solids	165.00-170.00
18-8 turnings	95.00-100.00
430 clips, bundles, solids	80.00-85.00
430 turnings	15.00-25.00†

YOUNGSTOWN

No. 1 heavy melting	*39.00-40.00*
No. 2 heavy melting	25.00-26.00†
No. 1 busheling	*39.00-40.00*
No. 1 bundles	*39.00-40.00*
No. 2 bundles	25.00-26.00†
Machine shop turnings	17.00-18.00
Shovel turnings	22.00-23.00
Cast iron borings	22.00-23.00
Low phos.	*41.00-42.00*
Electric furnace bundles	*41.00-42.00*

Railroad Scrap

No. 1 R.R. heavy melt.	*41.00-42.00*

CINCINNATI

(Brokers' buying prices; f.o.b. shipping point)

No. 1 heavy melting	35.00-36.00
No. 2 heavy melting	*28.00-29.00*
No. 1 bundles	36.00-37.00
No. 2 bundles	21.00-22.00
No. 1 busheling	35.00-36.00
Machine shop turnings	9.00-10.00
Mixed borings, turnings	12.00-13.00
Shovel turnings	14.00-15.00
Cast iron borings	14.00-15.00
Low phos., 18 in.	40.00-41.00

Cast Iron Grades

No. 1 cupola	34.00-35.00
Heavy breakable cast	30.00-31.00
Charging box cast	34.00-35.00
Drop broken machinery	46.00-47.00

Railroad Scrap

No. 1 R.R. heavy melt.	40.00-41.00
Rails, 18 in. and under	48.00-49.00
Rails, random lengths	42.00-43.00

DETROIT (Brokers' buying prices)

No. 1 heavy melting	33.00-34.00
No. 2 heavy melting	25.00-26.00
No. 1 bundles	*34.00-35.00*
No. 2 bundles	23.00-24.00
No. 1 busheling	32.00-33.00
Machine shop turnings	10.00-11.00
Mixed borings, turnings	11.00-12.00
Shovel turnings	12.00-13.00

Cast Iron Grades

No. 1 cupola	*33.00-34.00*
Mixed cast	*30.00-31.00*
Stove plate	28.00-29.00
Heavy breakable	27.00-28.00
Unstripped motor blocks	22.00-23.00
Clean auto cast	39.00-40.00

Stainless Steel Scrap

18-8 bundles & solids	170.00-175.00
18-8 turnings	70.00-75.00
430 bundles & solids	70.00-75.00

PHILADELPHIA

No. 1 heavy melting	40.00-41.00
No. 2 heavy melting	36.00-37.00
No. 1 bundles	*43.00*
No. 2 bundles	26.00-27.00
No. 1 busheling	*43.00*
Electric furnace bundles	45.00
Mixed borings, turnings	17.00†
Shovel turnings	20.00
Machine shop turnings	14.00
Heavy turnings	25.00†
Structurals & plates	45.00-46.00
Couplers, springs, wheels	*46.00*
Rail crops, 2 ft & under	52.00-54.00

Cast Iron Grades

No. 1 cupola	40.00
Heavy breakable cast	42.00
Drop broken machinery	49.00-50.00†
Malleable	49.00†

NEW YORK (Brokers' buying prices)

No. 1 heavy melting	30.00-31.00
No. 2 heavy melting	23.00-24.00
No. 1 bundles	30.00-31.00
No. 2 bundles	20.00-21.00
Machine shop turnings	4.50-5.00†
Mixed borings, turnings	5.00-5.50†
Shovel turnings	6.00-7.00†
Low phos. structurals & plates	34.00-35.00

Cast Iron Grades

No. 1 cupola	34.00-35.00
Unstripped motor blocks	25.00-26.00
Heavy breakable	32.00-33.00

Stainless Steel

18-8 sheets, clips, solids	160.00-165.00
18-8 borings, turnings	70.00-75.00
410 sheets, clips, solids	40.00-45.00
430 sheets, clips, solids	55.00-60.00

BOSTON

(Brokers' buying prices; f.o.b. shipping point)

No. 1 heavy melting	28.50-29.00
No. 2 heavy melting	25.00-26.00
No. 1 bundles	28.00-29.00
No. 1 busheling	28.50-29.00
Machine shop trunings	5.00-6.00
Shovel turnings	9.00-9.50
No. 1 cast	39.00-40.00
Mixed cupola cast	32.00-33.00
No. 1 machinery cast	40.00-42.00

ST. LOUIS (Brokers' buying prices)

No. 1 heavy melting	35.00
No. 2 heavy melting	30.00
No. 1 bundles	35.00
No. 2 bundles	25.00
No. 1 busheling	35.00
Machine shop turnings	16.50
Shovel turnings	18.50

Cast Iron Grades

No. 1 cupola	*36.00*
Charging box cast	34.00
Heavy breakable cast	32.00
Unstripped motor blocks	34.00
Clean auto cast	38.00
Stove plate	*31.50*

Railroad Scrap

No. 1 R.R. heavy melt.	*38.00*
Rails, random lengths	*42.00*
Rails, rerolling	55.00
Rails, 18 in. and under	*45.00*
Railroad specialties	*42.00*
Angles, splice bars	40.00†

BIRMINGHAM

No. 1 heavy melting	39.00-40.00
No. 2 heavy melting	30.00-31.00
No. 1 bundles	39.00-40.00
No. 2 bundles	22.00-23.00
No. 1 busheling	40.00-41.00
Cast iron borings	10.00-11.00
Machine shop turnings	18.00-19.00
Shovel turnings	20.00-21.00
Bar crops and plate	44.00-45.00
Structurals & plate	44.00-45.00
Electric furnace bundles	40.00-41.00
Electric furnace:	
3 ft and under	38.00-39.00
2 ft and under	39.00-40.00

Cast Iron Grades

No. 1 cupola	42.00-43.00
Stove plate	42.00-43.00
Unstripped motor blocks	31.00-32.00
No. 1 wheels	34.00-35.00

Railroad Scrap

No. 1 R. R. heavy melt.	39.00-40.00
Rails, rerolling	51.00-52.00
Rails, 2 ft and under	46.00-47.00
Rails, random lengths	42.00-43.00
Angles, splice bars	43.00-44.00

HOUSTON

(Brokers' buying prices; f.o.b. car)	
No. 1 heavy melting	36.00-37.00
No. 2 heavy melting	33.00-34.00
No. 1 bundles	38.00-39.00
No. 2 bundles	24.00-25.00
Machine shop turnings	12.50-13.00
Crushed turnings	19.00
Low phos. plate & structurals:	
3 ft	41.00-42.00
2 ft and under	47.00-48.00

Cast Iron Grades

No. 1 cupola	41.50-42.50
Heavy breakable	25.00-26.00
Foundry malleable	29.00-30.00
Unstripped motor blocks	30.00-31.00

Railroad Scrap

R.R. heavy melt. (3 ft)	40.00-41.00

LOS ANGELES

No. 1 heavy melting	43.00-45.00
No. 2 heavy melting	40.00
No. 1 bundles	42.00
No. 2 bundles	29.00-30.00
No. 2 bundles (export)	30.00-31.00
Machine shop turnings	20.00
Shovel turnings	20.00
Cast iron borings	17.00-18.00
Electric furnace scrap	50.00-52.00

Cast Iron Grades

No. 1 cupola	46.00-47.00

Railroad Scrap

No. 1 R.R. heavy melt.	43.00-45.00

PORTLAND, OREG.

(Prepared, f.o.b. car)

No. 1 heavy melting	49.00
No. 2 heavy melting	45.00
No. 2 bundles	35.00
Shovel turnings	18.00
Electric furnace	54.00

Cast Iron Grades

No. 1 cupola	41.00
Heavy breakable	38.00
Unstripped motor blocks	38.00
Stove plate (f.o.b. plant	37.00

SEATTLE (Prepared, f.o.b. car)

No. 1 heavy melting	49.00
No. 1 hvy (unprepared)	44.00
No. 2 heavy melting	45.00
No. 2 hvy (unprepared)	40.00
No. 2 bundles	35.00
Shovel turnings	16.00-18.00
Electric furnace	52.00

Cast Iron Grades

No. 1 cupola	41.00
Heavy breakable cast	38.00
Stove plate (f.o.b. plant)	36.00
Unstripped motor blocks	37.00

SAN FRANCISCO

No. 1 heavy melting	43.00**
No. 2 heavy melting	40.00**
No. 1 bundles	34.00**
No. 2 bundles	29.00**
Machine shop turnings	16.00-18.00
Mixed borings, turnings	16.00-18.00
Cast iron borings	16.00-18.00
Heavy turnings	16.00-18.00
Shovel turnings	16.00-18.00

Cast Iron Grades

No. 1 cupola	47.00
Charging box cast	34.00
Stove plate	34.00
Heavy breakable cast	28.00
Unstripped motor blocks	31.00
Clean auto cast	40.00
Drop broken machinery	45.00-46.00
No. 1 wheels	34.00

HAMILTON, ONT.

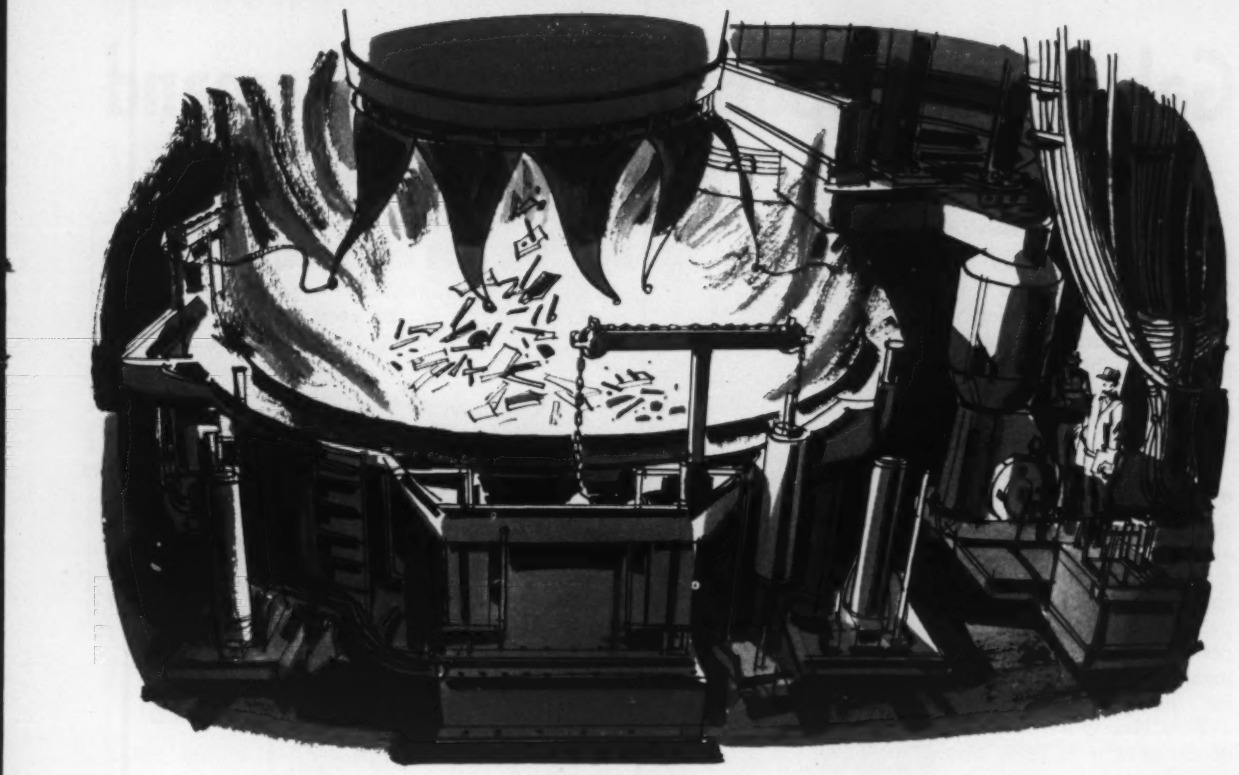
(Brokers' buying prices; net tons)	
No. 1 heavy melting	30.00
No. 2 hvy melt, 2 ft & under	29.00
No. 1 bundles	31.00
No. 2 bundles	23.50
Mixed steel scrap	22.00
Mixed borings, turnings	12.00
Busheling, new factory:	
Prepared	30.00
Unprepared	24.00
Shovel turnings	12.00

Cast Iron Grades‡

No. 1 machinery cast	32.00

**Based mainly on export sales.
†Nominal.
‡F.o.b. Hamilton, Ont.
§Delivered.

DANGEROUS INTRUDERS IN IRON AND STEEL SCRAP



COPPER . . . FRIEND OR FOE?

Because it is one of the most adaptable of metals, copper can be used either in its pure state or as an alloy with a wide variety of other metals.

The steel industry values copper as an element in certain steel compositions because it acts as a strengthening agent. Its presence also increases the resistance of steel to the harmful effects of atmospheric corrosion. These qualities make copper an important element in the weight-saving, high strength low alloy steels. For such steels, copper is a friend.

However, if copper enters the furnace as an unknown part of the charge, it becomes an undesired residual element. It will alloy with the molten metal, making the finished steel unfit for its intended use. In certain ranges of composition, it will impair the response of steel to fabrication by hot working or deep drawing. In the electric furnace, it is particularly undesirable. The presence of this non-oxidizable element may make it necessary to divert, or possibly force the scrapping of the entire heat.

When any of these situations occur, copper is a definite foe.

For guaranteed analysis of stainless and alloy steel scrap, look to Luria. Our personnel, equipment and strategically located facilities are specifically geared to work for you. We welcome your inquiry.

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Galvanizers Spur Hefty Zinc Demand

Nonferrous Metal Prices, Pages 218 & 219

SLAB ZINC shipments appear to be headed for a four year high. Unless demand falls drastically during the fourth quarter, shipments for the year should hit over 900,000 tons, a solid improvement from the 831,238 tons shipped in 1960. That would be the best year since 1957.

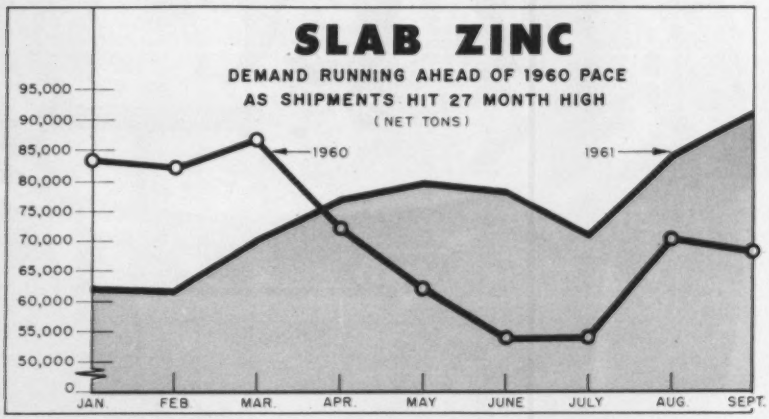
• **Slow Start** — The year started slowly, then began to pick up steam at the beginning of the second quarter. Through the first nine months, shipments totaled 674,143 tons compared with 632,803 tons in the same period last year. September shipments hit a whopping 91,029 tons for the best month since June, 1959. This is a complete reversal of the pattern in 1960. (See graph at right.)

Zincmen expect a high level of shipments over the fourth quarter. Business may be even better than forecast if automakers decide to step up buying of special high grade zinc. Special high grade sales have been disappointing this year, mainly because of less buying by Detroit. Demand has picked up recently, but there's still room for improvement.

• **Galvanizing Strong**—The big demand for zinc (prime western) has come from the makers of galvanized steel sheets. STEEL estimates that mill shipments of galvanized sheets will set a record of 3.3 million tons this year (vs. the record 3,056,996 tons in 1960).

• **Consumption Lags Shipments**—Zinc consumption is probably running behind shipments. Indications are most users entered the year with small stocks and have been gradually rebuilding them.

Production has been running behind shipments since the start of the second quarter. The result has been a steady decline in producer stocks.



Source: American Zinc Institute Inc.

They've now fallen for six months and stand at 165,064 tons compared with 206,372 tons in January.

• **Price Should Hold**—When demand takes a big jump as it did in September, there's always the possibility of an increase in price. Metalmen, however, don't look for any early move in this direction. Some believe that if demand continues strong there could be a modest increase—about 0.5 cent a pound—late in the quarter.

Certain zinc prices are still a little weak. Most producers continue to grant a 0.5 cent a pound discount below the published price on special high grade zinc and the diecasting alloys.

• **Auto Uses Gain**—Zinc consumption by automakers is on the upswing. Usage in 1962 models—mostly in galvanized and diecastings—will increase by at least 10 per cent, predicts John L. Kimberley, executive vice president of the American Zinc Institute Inc.

Mr. Kimberley estimates the average (full size) '62 car will use about 80 lb of zinc diecastings compared with 75 lb in '61 models. The average '62 compact will take about 35 lb vs. 30 lb in 1961 models.

Lead-Zinc Bill Signed

President Kennedy has signed a compromise bill for aid to small lead-zinc miners. The new act authorizes limited subsidy payments over a four year period to miners who since 1955 have not produced more than 3000 tons of the two metals in any one year. Payments will be made on the basis of 75 per cent of the difference between the market price and 14.5 cents for lead and 55 per cent of the difference between the market price and 14.5 cents for zinc. Payments in the first year will cover up to 3000 tons production for each producer, and thereafter will be scaled down, falling to 1200 tons in the fourth year. Cost: $16.5 million over the four years.

You'll probably hear more about lead-zinc legislation in the next session of Congress. The Small Producer Act affects only a minute portion of U. S. production. Western congressmen will probably press for a subsidy-tariff measure that's more all inclusive.

In the meantime, the U. S. Tariff Commission will conduct a study of the industry. A public hearing is scheduled for Jan. 16 at Tariff Commission headquarters.

Now is the time for all good men...

to listen to the voice of patriotism!

Many companies have the Treasury Payroll Saving Plan. Some don't promote it enough! They don't realize how the plan works for our country . . . and for them.

For example, it strengthens local buying power. It provides a hard-to-beat employee benefit program. It acts as an economic insurance policy. Fill in the coupon and get easy-to-use promotion ideas that work!

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U.S. Savings Bonds Division
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The U.S. Government does not pay for this advertisement. The Treasury Department thanks, for their patriotism, The Advertising Council and this magazine.

Nonferrous Metals

Cents per pound, carlots except as otherwise noted.

PRIMARY METALS AND ALLOYS

Aluminum: 99.5%, 30 and 50 lb ingots, 24.00, 30,000 lb or more, f.o.b. customer custody.

Aluminum Alloy: No. 13, 25.20; No. 43, 25.30; No. 195, 26.70; No. 214, 28.10; No. 356, 26.00, 30 and 50 lb ingots.

Antimony: R.M.M. brand, 95.5%, 32.50; Lone Star brand, 33.00, f.o.b. Laredo, Tex., in bulk. Foreign brands, 99.5%, 30.50-31.00, New York, duty paid, 10,000 lb or more.

Beryllium: 97% lump or beads, $70.00 per lb, f.o.b. Cleveland or Reading, Pa.

Beryllium Aluminum: 5% Be, $65 per lb of contained Be, with balance as Al at market price, f.o.b. shipping point.

Beryllium Copper: 3.75-4.75% Be, $43 per lb of contained Be, with balance as Cu at market price on shipment date, f.o.b. shipping point.

Bismuth: $2.25 per lb, ton lots.

Cadmium: Sticks and bars, $1.70 per lb deld.

Cobalt: 99+%, $1.50 per lb for 500-lb keg; $1.52 per lb for 100 lb case; $1.57 per lb under 100 lb.

Columbium: Powder, $40 per lb and up nom.

Copper: Electrolytic, 31.00 deld; custom smelters, 31.00 nom; lake, 31.00 deld; fire refined, 30.75.

Germanium: Purified, Ingots, less than 1 kg 37.50 per gram; 1-10 kg 32.00 per gram; 10 kg or more, 29.95 per gram; intrinsic grade, under 10 kg, 31.95 per gram; 10 kg or more, 29.95 per gram.

Gold: U. S. Treasury, $35 per oz.

Indium: 99.9%, $2.25 per troy oz.

Iridium: $70-75 per troy oz nom.

Lead: Common, 10.80; chemical, 10.90; corroding, 10.90; St. Louis, New York basis, add 0.20.

Lithium: 1 lb or 2 lb ingots, less than 24 lb, $11 per lb deld; 24-99 lb, $9.50; 100-449 lb, $9.25; 450 lb or more, $9 per lb, delivered.

Magnesium: Pig, 35.25; ingot, 36.00 f.o.b. Velasco, Tex., 1.3 in. diam. x 12 in. sticks, 57.00 f.o.b. Madison, Ill.

Magnesium Alloy: AZ91A (diecasting), 40.75; AZ63A, AZ92A, AZ91C (sand casting), 40.75 f.o.b. Velasco, Tex.

Mercury: Open market, spot, New York, $188-191 per 76 lb flask.

Molybdenum: Unalloyed forging billets, 4.125-8.5 in. diam., 50-4999 lb, $8.15 per lb, depending on quantity; 5000 lb or more, $8 per lb, f.o.b. Coldwater, Mich.

Nickel: Electrolytic cathodes, briquettes, sheets (4 x 4 in. and larger), unpacked, 81.25; 10-lb pig, unpacked, 89.00; "XX" nickel shot, 88.75; "F" nickel shot for addition to cast iron, in kegs, 81.75; "F" nickel, 5 lb ingots, 82.75. Prices f.o.b. Port Colborne, Ont., including import duty. New York basis, add 1.09. Nickel oxide sinter at Buffalo, New York, or other established U. S. ports of entry, contained nickel, 77.50.

Osmium: $40-90 per troy oz nom.

Palladium: $24-26 per troy oz.

Platinum: $82-85 per troy oz from refineries.

Radium: $16-21.50 per mg radium content, depending on quantity.

Rhodium: $137-140 per troy oz.

Ruthenium: $55-60 per troy oz.

Selenium: $6.50 per lb, commercial grade.

Silver: Open market, 91.375 per troy oz.

Sodium: Solid pack, c.l., 19.50; l.c.l., 20.00; 5 and 12 lb bricks, c.l., 21.00; l.c.l., 21.50; tank car, 17.00.

Tantalum: Melting stock, $35 per lb; rod, $60 per lb nom; sheet, $55 per lb nom.

Tellurium: $5.25 per lb, 100 lb or more.

Thallium: $7.50 per lb.

Tin: Straits, N. Y., spot and prompt, 121.125.

Titanium: Sponge, 99.3+% grade A-1, ductile (0.3% Fe max), $1.37 per lb; grade A-2 (0.5% Fe max), $1.50 per lb.

Tungsten: Powder, 98.8%, carbon reduced, 100-lb lots, $2.75 per lb nom., f.o.b. shipping point; less than 1000 lb, add 15.00c; 99+% hydrogen reduced, $3.25.

Zinc: Prime Western, 11.50; brass special 11.70; intermediate, 11.70, East St. Louis, freight allowed over 0.50 per lb. New York basis, add 0.50. High grade, 12.35; special high grade, 12.50 deld. Diecasting alloy ingot No. 3, 13.75; No. 2, 14.25; No. 5, 14.00 deld.

Zirconium: Reactor grade sponge, 100 lb or less, $7.25-7.75 per lb; 100-500 lb, $6.75-7.25 per lb; 500-1000 lb, $6.25-6.75; over 1000 lb, $6.25 per lb.

(Note: Chromium, manganese, and silicon metals are listed in ferroalloy section.)

SECONDARY METALS AND ALLOYS

Aluminum Ingot: Piston alloys, 24.00; No. 12 foundry alloy (No. 2 grade), 21.25; 5% silicon alloy, 0.60 Cu max, 23.00; 13 alloy, 0.60 Cu max, 23.00; 195 alloy, 24.25; 108 alloy, 21.75. Steel deoxidizing grades, notch bars, granulated or shot: Grade 1, 22.75; grade 2, 21.50; grade 3, 20.50; grade 4, 19.50.

Brass Ingot: Red brass, No. 115, 32.00; tin bronze, No. 225, 41.25; No. 245, 35.75; high leaded tin bronze, No. 305, 36.00; No. 1 yellow, No. 405, 27.50; manganese bronze, No. 421, 31.25.

Magnesium Alloy Ingot: AZ63A, 37.50; AZ91B, 37.25; AZ91C, 41.25; AZ92A, 37.50.

NONFERROUS PRODUCTS

BERYLLIUM COPPER

(Base prices per lb, plus mill extras, 2000 to 5000 lb; nom. 1.9% Be alloy.) Strip, $1.955, f.o.b. Temple, Pa., or Reading, Pa., rod, bar, wire, $1.955, f.o.b. Temple, Pa.

COPPER WIRE

Bare, soft, f.o.b. eastern mills, 20,000-lb lots, 36.35; l.c.l., 36.98. Weatherproof 20,000-lb lots, 37.05; l.c.l., 37.80.

LEAD

(Prices to jobbers, f.o.b. Buffalo, Cleveland, Pittsburgh.) Sheets, full rolls, 140 sq ft or more, $16.50 per cwt; pipe, full coils, $16.50 per cwt; traps and bends, list prices plus 30%.

TITANIUM

(Prices per lb, 10,000 lb and omer, f.o.b. mill.) Sheets and strip, $5.70-15.50; sheared mill plate, $4.45-9.00; wire, $5.00-9.50; forging billets, $3.00-4.75; hot-rolled and forged bars, $3.39-6.25.

ZINC

(Prices per lb, c.l., f.o.b. mill.) Sheets, 28.00; ribbon zinc in coils, 22.50; plates, 21.50.

ZIRCONIUM

Plate, $11.00-16.00; H.R. strip, $11.00-15.00; C.R. strip, $13.00-18.00; forged or H.R. bars, $11.00-15.00.

NICKEL, MONEL, INCONEL

	"A" Nickel	Monel	Inconel
Sheets, C.R.	147	126	145
Strip, C.R.	133	114	145
Plate, H.R.	134	116	133
Rod, Shapes, H.R.	116	95	116
Seamless Tubes	157	129	200

ALUMINUM

(Selected products and sizes)

Flat Sheets: 1100, 3003, and 5005, mill finish, 30,000 lb base f.o.b. customer custody.

Thickness Range (in.)	Width (in.)	Length Range (in.)	Price Range
0.250-0.183	24-72	72-180	44.40-47.00
0.183-0.154	24-72	72-180	44.40-47.00
0.154-0.120	24-72	72-180	44.90-47.80
0.120-0.096	24-72	72-180	44.90-47.80
0.096-0.076	24-72	72-180	45.40-49.30
0.076-0.060	24-72	72-180	45.90-50.10
0.060-0.047	24-72	72-180	46.40-51.30
0.047-0.037	24-72	72-180	46.90-52.70
0.037-0.030	24-72	72-180	47.40-54.30
0.030-0.023	24-60	72-180	47.90-56.10
0.023-0.018	24-48	72-144	48.40-56.40
0.018-0.014	24-48	72-144	50.20-57.00
0.014-0.011	24-48	72-144	52.50-59.00
0.011-0.0085	24-36	72-96	55.20
0.0085-0.007	24-36	72-96	58.20
0.007-0.006	24-36	72-96	61.00

ALUMINUM (continued)

Plates: 1100, 3003, and 5005, mill finish, 0, H12, and H14 tempers, 30,000 lb base f.o.b. customer custody.

Thickness Range (in.)	Width (in.)	Length Range (in.)	Price Range
3.000-2.000	6-144	72-240	45.10-50.00
2.000-1.251	6-144	72-240	45.50-50.30
1.251-0.751	6-144	72-240	44.50-49.60
0.751-0.250	6-144	72-240	44.50-49.60

Screw Machine Stock: 30,000 base, 12 ft lengths.

Diam (in.)*	Round 2011-T3	Round 2017-T4	Hexagonal 2011-T3	Hexagonal 2017-T4
0.125	74.90	76.30	....	....
0.188	63.20	62.20	....	79.10
0.250	60.00	61.60	72.70	73.10
0.375	59.20	62.80	71.00	71.00
	2011-T3	2017-T451	2011-T2	2017-T451
0.500	59.20	62.80	71.00	71.00
0.625	59.20	62.80	67.80	66.90
0.750	57.70	61.00	61.60	62.80
0.875	57.70	61.00	61.60	62.80
1.000	57.70	61.00	61.60	62.80
1.125	55.30	58.50	59.50	60.50
1.375	55.30	58.50	59.50	60.50
1.500	55.30	58.50	59.50	60.50
1.625	53.00	55.70	....	58.30
1.750	53.00	55.70	58.30	58.30
1.875	53.00	55.70	....	58.30
2.000	53.00	55.70	58.30	58.30
2.250	51.50	54.00	....	58.30
2.500	51.50	54.00	....	58.30
2.750	49.90	52.20	....	58.30
3.000	49.00	52.20	....	58.30
3.250	....	52.20	....	....
3.375	....	52.20	....	....

*Selected sizes.

Forging Stock: Rounds, Class 1, random length, diam., 0.375-8 in., "F" temper; 2014, 45.50-55.60; 6061, 41.50-55.60; 7075, 58.50-64.60; 7079, 58.50-66.60.

Pipe: ASA schedule 40, alloy 6063-T6, 3-40 ft lengths, plain ends, 90,000 lb base, dollars per ft. Nominal pipe sizes: 1 in., 32.00; 1¼ in., 43.40; 1½ in., 51.80; 2 in., 62.60; 3 in., 124.95; 4 in., 171.80; 5 in., 233.15; 6 in., 308.55; 8 in., 464.35; 10 in., 716.25 (3-24 ft lengths).

Extruded Solid Shapes

Factor	Alloy 6063-T5	Alloy 6062-T6
1-14	45.30-46.80	54.00-60.00
15-17	45.30-46.80	56.50-61.80
18-23	45.80-47.50	58.60-67.00
24-32	45.80-47.50	66.80-81.50
33-38	49.50-52.20	85.10-96.60
39-44	59.80-63.60	102.00-124.00

MAGNESIUM

Sheets and Plates: AZ31B standard grades, .032 in., 103.10; .081 in., 77.90; .125 in., 70.40; .188 in., 69.00; .250-2.00 in., 67.90. AZ31B spec. grades, .032 in., 171.30; .081 in., 108.80; .125 in., 98.10; .188 in., 95.70; .250-2.00 in., 93.30. Tread plate, 60-192 in. lengths, 24.72 in. width; .125 in., 74.90; .188 in., 71.70-72.70; .25-.75 in., 70.60-71.60. Tooling plate, 0.25-3.00 in., 73.00.

Extruded Solid Shapes:

Factor	(AZ31C) Com. Grade	(AZ31B) Spec. Grades
6-8	65.30-67.60	84.60-87.40
12-14	65.30-67.60	85.70-88.00
24-26	66.10-68.40	90.60-91.30
36-38	71.50-75.30	104.20-105.30

NONFERROUS SCRAP

DEALER'S BUYING PRICES

Copper and Brass: No. 1 heavy copper and wire, 23.50-24.00; No. 2 heavy copper and wire, 21.50-22.00; light copper, 18.75-19.25; No. 1 composition red brass, 21.50-22.00; No. 1

BRASS MILL PRICES

(Copper or Copper Alloy No.)	MILL PRODUCTS a Sheet, Strip, Plate	Rod	Wire	Seamless Tubes	SCRAP ALLOWANCES d (Based on copper at 31.00c) Clean Heavy	Rod Ends	Clean Turnings
Copper (110)	56.13b	50.36-51.36	....	57.32	27.00	27.00	26.25
Yellow Brass (268, 270)	49.27	35.77c	49.56	53.43	20.375	19.50c	18.50c
Low Brass, 80% (240)	52.15	52.09	52.44	56.21	22.875	22.625	22.125
Red Brass, 85% (230)	53.17	53.11	53.46	57.23	23.875	23.625	23.125
Com. Bronze, 90% (220)	54.73	54.67	55.02	58.54	24.75	24.50	24.00
Manganese Bronze (675)	57.69	51.27	61.54	....	19.25	19.00	18.50
Muntz Metal (365)	51.94	47.25	....	....	19.125	18.875	18.375
Naval Brass (464)	53.94	47.75	60.25	58.10	19.00	18.75	18.25
Silicon Bronze (651)	61.39	60.58	60.68	79.80	26.50	26.25	25.75
Nickel Silver, 10% (745)	65.56	67.16	66.91	....	26.00	25.75	13.00
Phos. Bronze, A-5% (510)	76.97	77.47	76.72	78.90	28.50	28.25	27.25

a. Cents per lb, f.o.b. mill; freight allowed on 50 lb or more. b. Hot-rolled. c. Free cutting. d. Prices in cents per lb for less than 20,000 lb, f.o.b. shipping point. On lots over 20,000 lb at one time of any or all kinds of scrap, add 1 cent per lb.

composition turnings, 20.50-21.00; new brass clippings, 17.50-18.00; light brass, 14.50-15.00; heavy yellow brass, 15.50-16.00; new brass rod ends, 16.50-17.00; auto radiators, unsweated, 17.50-18.00; cocks and faucets, 18.00-18.50; brass pipe, 17.50-18.00.

Lead: Soft scrap lead, 7.25-7.50; battery plates, 3.00-3.25; linotype and stereotype, 8.50-8.75; electrotype, 8.00-8.25; mixed babbitt, 10.00-10.50.

Monel: Clippings, 26.00-26.50; old sheets, 25.00-25.50; turnings, 18.50-19.00; rods, 25.00-25.50.

Nickel: Sheets and clips, 56.00-58.00; rolled anodes, 56.00-58.00; turnings, 43.00; rod ends, 56.00-58.00.

Zinc: Old zinc, 3.00-3.25; new diecast scrap, 3.00-3.50; old diecast scrap, 1.75-2.00.

Aluminum: Old castings and sheets, 8.50-9.00; clean borings and turnings, 4.00-4.50; segregated high copper clips, 9.75-10.25; mixed low copper clips, 10.25-10.75; mixed high copper clips, 9.75-10.25.

(Cents per pound, Chicago)

Aluminum: Old castings and sheets, 8.50-9.00; clean borings and turnings, 6.00-6.50; segregated low copper clips, 13.00-13.50; segregated high copper clips, 12.00-12.50; mixed low copper clips, 11.50-12.00; mixed high copper clips, 11.00-11.50.

(Cents per pound, Cleveland)

Aluminum: Old castings and sheets, 9.75; clean borings and turnings, 8.50; segregated low copper clips, 13.00; segregated high copper clips, 12.25; mixed low copper clips, 12.25; mixed high copper clips, 12.50.

REFINERS' BUYING PRICES

(Cents per pound, carlots, delivered refinery)
Beryllium Copper: Heavy scrap, 0.020-in. and heavier, not less than 1.5% Be, 57.00; light scrap, 52.00; turnings and borings, 37.00.

Copper and Brass: No. 1 heavy copper and wire, 27.25; No. 2 heavy copper and wire, 25.25; light copper, 23.00; refinery brass (60% copper) dry copper content, 24.00.

INGOTMAKERS' BUYING PRICES

Copper and Brass: No. 1 heavy copper and wire, 27.25; No. 2 heavy copper and wire, 25.25; light copper, 23.00; No. 1 composition borings, 24.00; No. 1 composition solids, 24.50; heavy yellow brass solids, 18.00; yellow brass turnings, 16.50; radiators, 20.00.

Plating Material

(F.o.b. shipping point, freight allowed on quantities)

ANODES

Cadmium: Special or patented shapes, $1.60.

Copper: Flat-rolled, 47.50; oval, 44.50; lectro-deposited, 37.50; cast, 42.50; 5000-10,000 lb quantities.

Nickel: Depolarized, less than 500 lb, 117.50; 500-1999 lb, 110.50; 2000-4999 lb, 107.00; 5000-29,999 lb, 106.00; 30,000 lb, 105.00. Carbonized, deduct 3 cents a lb.

Tin: Bar or slab, less than 200 lb, 140.50; 200-499 lb, 139.00; 500-999 lb, 138.50; 1000 lb or more, 138.00.

Zinc: Balls, 18.25; flat tops, 18.25; flats, 21.00; ovals, 20.85, ton lots.

CHEMICALS

Cadmium Oxide: $1.60 per lb in 100-lb drums.
Chromic Acid (flake): 100-2000 lb, 31.00; 2000-10,000 lb, 30.50; 10,000-20,000 lb, 30.00; 20,000 lb or more, 29.50.

Copper Cyanide: 100-200 lb, 65.90; 300-900 lb, 63.00; 1000-19,000 lb, 61.90.

Copper Sulphate: 100-1900 lb, 15.50; 2000-5900 lb, 13.50; 6000-11,900 lb, 13.25; 12,000-22,900 lb, 13.00; 23,000 lb or more, 12.50.

Nickel-Chloride: 100 lb, 47.50; 200 lb, 45.50; 300 lb, 44.50; 400-4900 lb, 42.50; 500-9900 lb, 40.50; 10,000 lb or more, 39.50.

Nickel Sulphate: 5000-22,999 lb, 31.00; 23,000-39,900 lb, 30.50; 40,000 lb or more, 30.00.

Sodium Cyanide (Cyanobrik): 200 lb, 23.80; 400-900 lb, 20.80; 1000-4900 lb, 19.80; 5000-19,900 lb, 18.80; 20,000 lb or more, 17.60.

Sodium Stannate: Less than 100 lb, 89.20; 100-600 lb, 79.50; 700-1900 lb, 76.80; 2000-9990 lb, 74.90; 10,000 lb or more, 73.60.

Stannous Chloride (Anhydrous): 100 lb, 148.40; 400 lb, 138.40; 800-19,000 lb, 117.10; 20,000 lb or more, 112.90.

Stannous Sulphate: Less than 50 lb, 155.70; 50 lb, 125.70; 100-1900 lb, 123.70; 2000 lb or more, 121.70.

Zinc Cyanide: 100-200 lb, 59.00; 300-900 lb, 57.00.

(*Concluded from Page 213*)

leave the port before the end of the year.

• **Los Angeles**—The market is weaker, both export and domestic demand being slack. Dealers are holding fairly large inventories.

(*Concluded from Page 210*)

PLATES . . .

PLATES PLACED

129 tons, carbon, Type 111, descaled and painted, Navy Purchasing Office, Washington, to Kaiser Steel Corp., Napa, Calif.

120 tons, 48 in. water mains, Queens County, New York, to Posey Iron Works, through Slattery Construction Co., New York.

PLATES PENDING

462 tons, carbon (three contracts), Military Industrial Supply Agency, Navy, Philadelphia; Kaiser Aluminum & Chemical Sales Inc., Philadelphia, awarded 212 tons of aluminum alloy plates.

113 tons, floor plates, Military Industrial Supply Agency, Navy, Philadelphia; bids Oct. 16; delivery to various destinations.

100 tons, 300,000 gallon water tank, King County District No. 58, Seattle; Pittsburgh-Des Moines Steel Co., Seattle, low bidder at $28,541.

100 tons or more, steel barges 110 by 34 ft, nonselfpropelled, Navy Purchasing Office, Washington; to be awarded in quantities of two, three, or five to small firms as prime contractors; bids Oct. 20, Washington.

100 tons, steel standpipe, Rock Island, Wash.; Pittsburgh-DesMoines Steel Co., Seattle, is low bidder at $13,530.

PIPE . . .

CAST IRON PIPE PLACED

224 tons, 6, 8, and 12 in., for Snoqualmie, Wash., to Pacific States Cast Iron Pipe Co., Seattle.

150 tons, system expansion, Pasco, Wash., to U. S. Pipe & Foundry Co., Seattle.

75 tons, 8 in., for Tacoma, Wash., to Pacific States Cast Iron Pipe Co., Seattle.

CAST IRON PIPE PENDING

300 tons, reservoir and improvements, Lake Forest Park, Seattle; bids in.

RAILS, CARS . . .

RAILROAD CARS PLACED

Norfolk & Western, 1000, eighty five ton coal hopper cars, to its own shops.

Southern Railways, 200, aluminum covered hopper cars, to Magor Car Corp., Clifton, N. J.

Louisville & Nashville, rebuilding 500, fifty ton hopper cars, to its own shops in South Louisville, Ky. Further expenditures will be made, including the purchase of 55, seventy ton covered hopper cars.

Union Pacific, ten, 85 ft piggyback flatcars, adapted for transport of solid fuel missiles, to the ACF's American Car & Foundry Div. plant in Berwick, Pa. Cars will be equipped with cushioned underframes to provide shock-free rail transportation of Air Force Minuteman missiles in their transporter trailers from assembly point to hard site launch locations.

RAILROAD CARS PENDING

Armour & Co., one-hundred-twenty, 10,000 gallon, aluminum tankcars to General American Transportation Corp., Chicago, on a lease basis.

Western Maryland, 25, fifty ton boxcars and 14, seventy ton flatcars, to Pullman-Standard Div., Chicago, Pullman Inc.

Northern Pacific, 50 piggyback trailers to Brown Trailer Div., Battle Creek, Mich., Clark Equipment Co.

Union Tank Car Corp., 75 tank cars, now being delivered from its own shops, 65 from Whiting, Ind., and 10 from Philadelphia.

CLASSIFIED

Machinery and Equipment Wanted

WANTED: ANNEALING FURNACE

Continuous roller type with cooling zone and cooling tower. Maximum heat 1850 degrees; radiant tube fired. Complete with all necessary instruments and controls.

O. F. MALY
VALLEY STEEL PRODUCTS CO.
Louisiana, Mo.
Phone: SKyline 4-4542

Help Wanted

WANTED — ASSISTANT SUPERINTENDENT blast furnace operation. Young well established completely integrated steel company located in great southwest area needs to fill key position in its blast furnace department with well qualified man age limit 45 years. Company currently engaged in multi-million dollar expansion program. Excellent opportunity. Submit complete resume giving personal history, education, experience and salary requirements. All replies held confidential. Box 961, STEEL, Penton Bldg., Cleveland 13, Ohio.

FERROUS METALLURGIST

Company engaged in extractive and pyrometallurgy requires well qualified graduate metallurgist for production, development and quality control who has experience in one or more of the following: smelting and refining, steel making, or electric furnace operation. Excellent opportunities for qualified man. Hospitalization, insurance, profit sharing and pension plan provided cost free by company. Opening at Kentucky plant. All replies held strictly confidential. Submit detailed resume, including educational and employment backgrounds, as well as salary requirements to Box 967, STEEL, Penton Bldg., Cleveland 13, Ohio.

CHIEF
MANUFACTURING ENGINEER

Graduate M.E. or equivalent w/extensive job shop, plant management experience in tool and die, stamping, plating. Salary commensurate with qualifications. Location East Tennessee. Real Opportunity for energetic, alert, flexible, growing team man. State education, experience, salary requirements and goals, picture to: Box 968, STEEL, Penton Bldg., Cleveland 13, Ohio.

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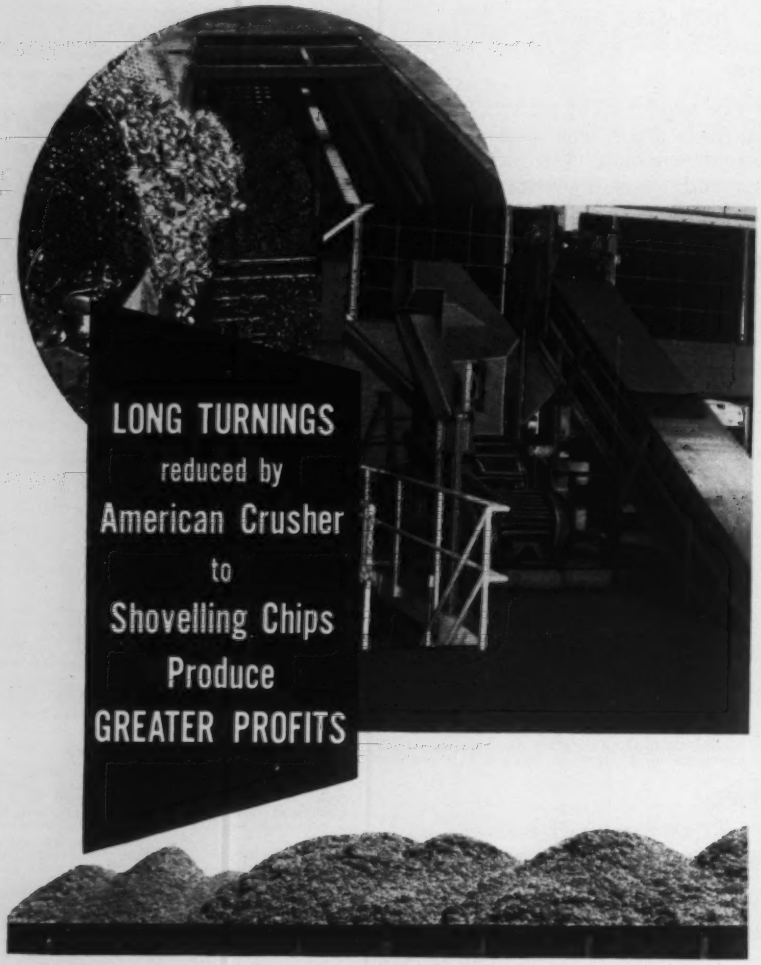

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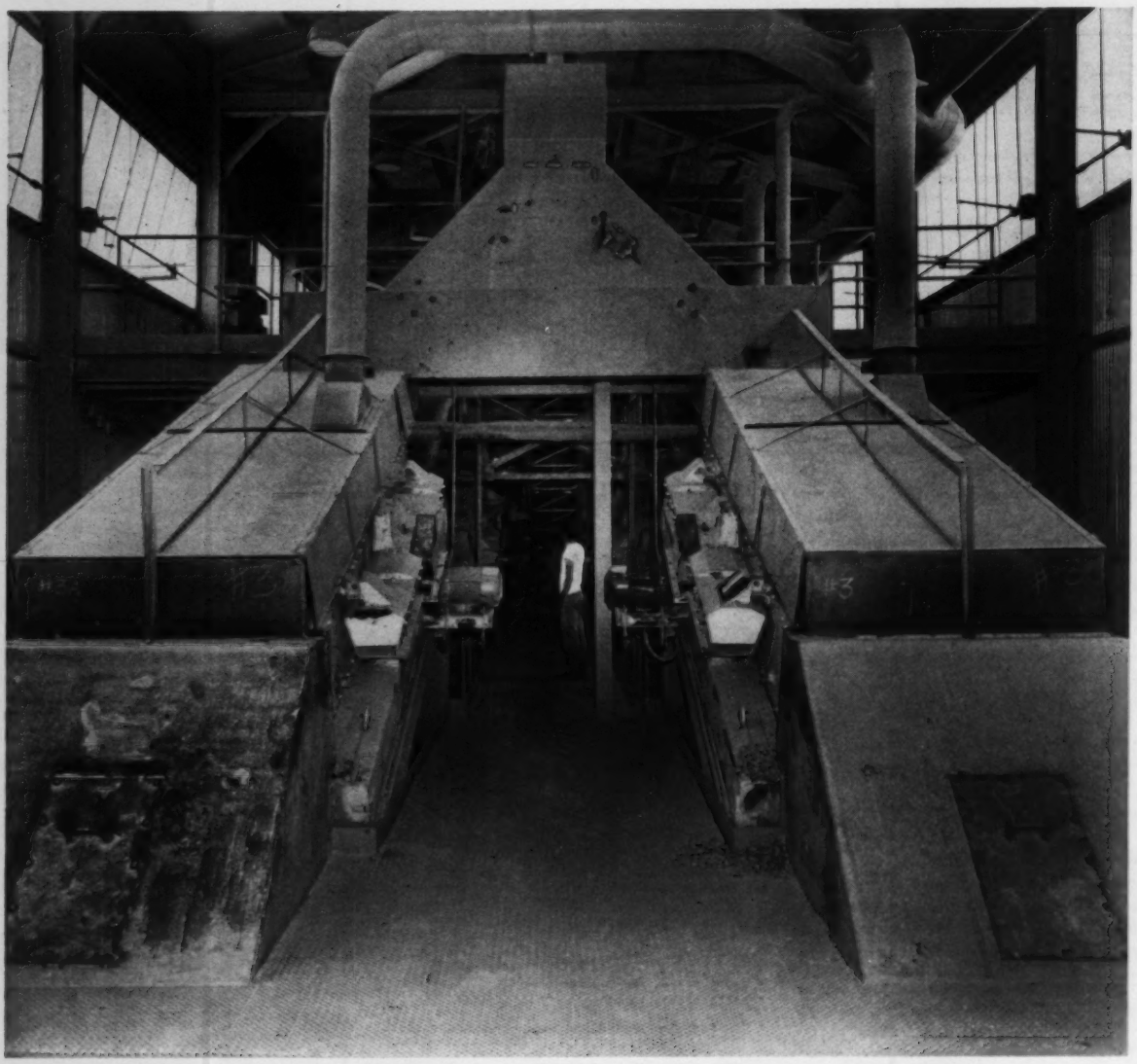

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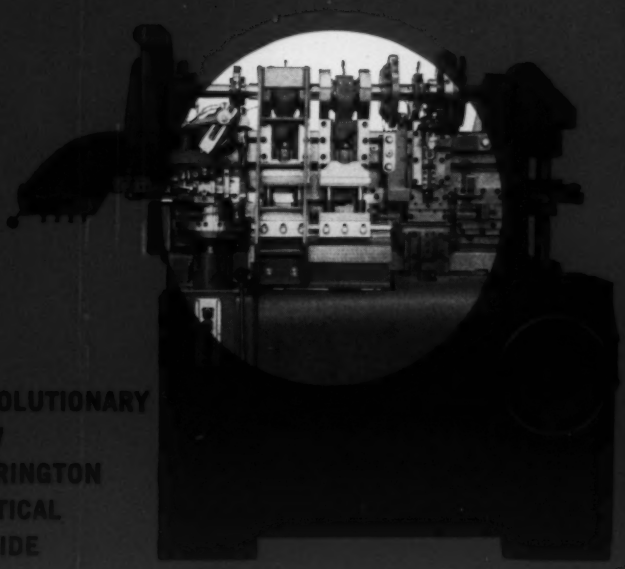

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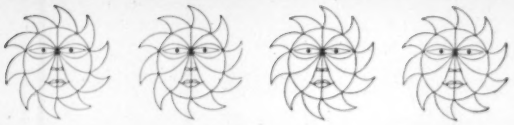

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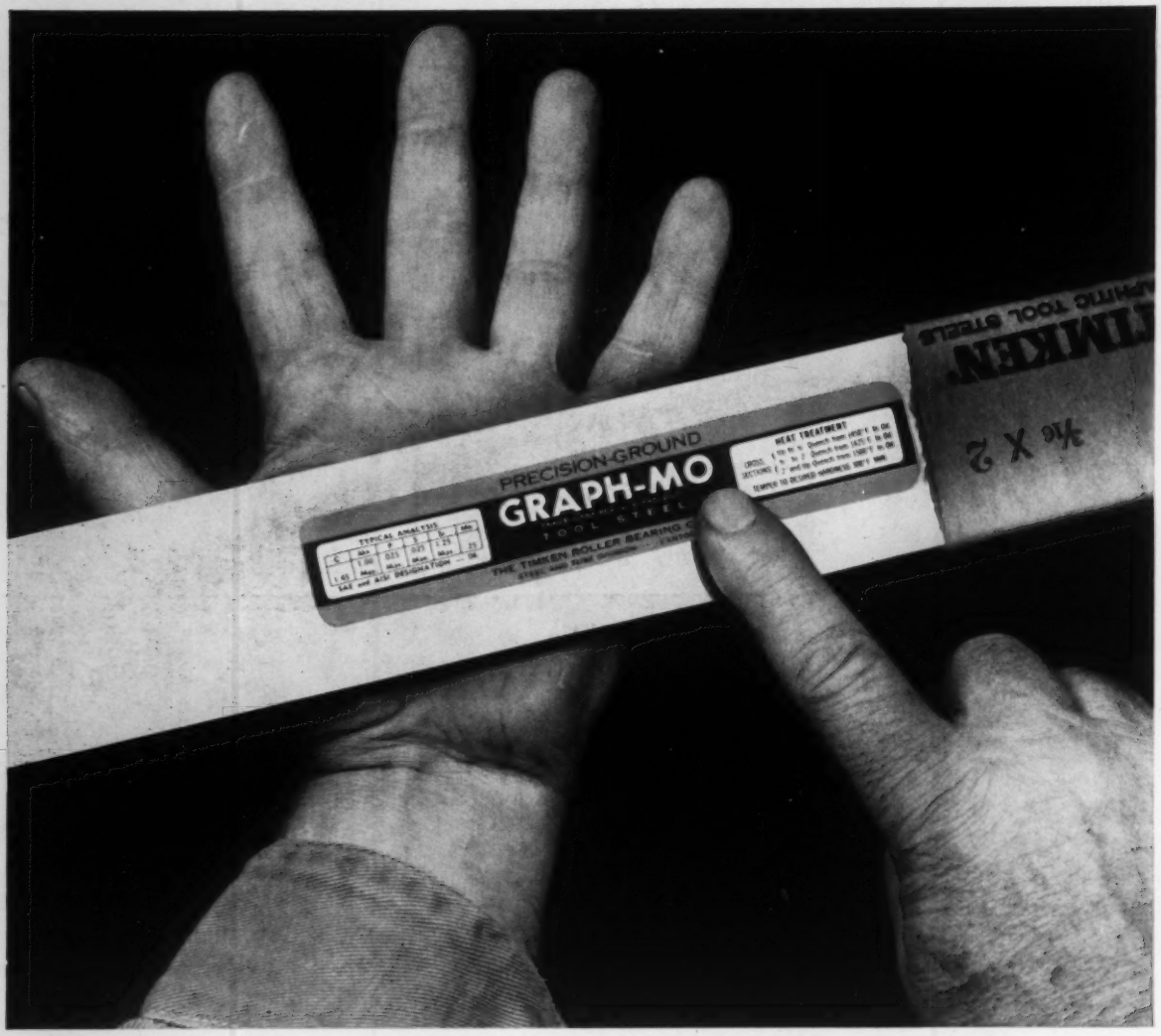

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